Project Manual

Wastewater Treatment Plant Improvements
Phase 1

DECEMBER 2024

Prepared for:

City of West University Place

Owner: **City of West University Place, Texas**
Bid Number: **PW24-18**

Prepared by:

Kimley»Horn

CONTRACT DOCUMENTS

FOR CONSTRUCTION OF

Wastewater Treatment Plant Improvements Phase 1

Prepared for:
City of West University Place, Texas
3800 University Boulevard
West University Place, TX 77005

Bid Number:
PW24-18

Project #:
067812104

Prepared by:

Texas Engineering Firm Registration Number: 928
11700 Katy Freeway, Suite 800
Houston, Texas 77079
Phone: (281) 597-9300

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Division 13: Special Construction (All)
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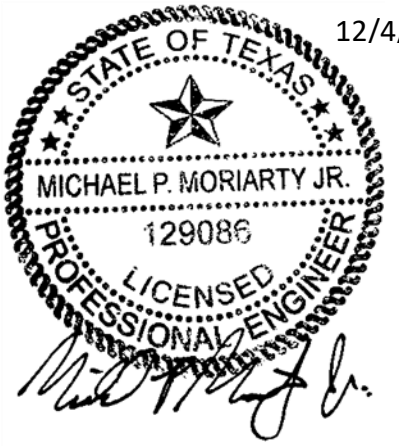

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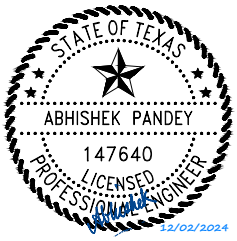

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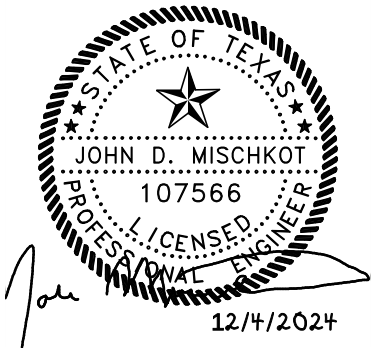

JQ Infrastructure, LLC
TBPELS Firm F-7986

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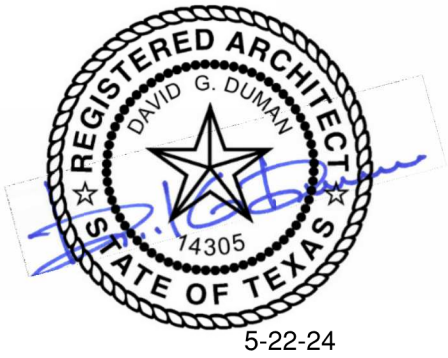

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NOTICE TO BIDDERS

Sealed Bids will be received by City of West University Place, Texas on **Friday, January 10, 2025,** until 10:00 AM, local time.

Sealed bids must be clearly marked " **PW24-18 WASTEWATER TREATMENT PLANT IMPROVEMENTS PHASE 1."** and delivered to the City Secretary's office located at 3800 University Boulevard, West University Place, Texas, to arrive no later than 10:00 A.M., local time, Friday, January 10, 2025. Bids received after that time will not be accepted. Bids will be opened publicly and read aloud at that time in the Bill Watson Conference Room located at City Hall at 3800 University Boulevard, West University Place, Texas 77005.

The proposed Work is generally described as follows: Work of the project consists of improvements to the existing 2.0 million gallon per day Wastewater Treatment Plant (WWTP) located at 2801 N Braeswood Blvd, Houston, TX 77025.

A Complete Set of Bid Documents including a more detailed Invitation to Bidders, Plans, and Specifications will be available beginning Wednesday, December 4, 2024, online through CivCast at http://www.civcastusa.com/. Search for "**West University Place PW24-18 WWTP Improvements Phase 1**". Bidders must register on this website to view and download specifications, plans, and other related documents for this project. There is NO charge to view or download documents.

There will be a **non-mandatory** Pre-Bid Conference held on **Wednesday, December 11, 2024**, at **2:00 PM** local time, at the WWTP (2801 N Braeswood Blvd, Houston, TX 77025, Texas).

Any questions regarding this BID must be submitted by 5:00 P.M. Wednesday, January 8, 2025, on CivCast.

Bid Security in the amount of five (5) percent of the greatest amount bid must accompany each bid. Bidders will be required to furnish verifiable references in the Statement of Contractor Qualifications with their bids/proposals.

The successful bidder must furnish a performance bond and a payment bond on the forms provided, each in the amount of 100% of the Contract price from a surety company licensed by the State of Texas.

The Owner reserves the right to accept or reject any or all Bids, to waive any and all informalities, and to disregard all nonconforming or conditional Bids or counter Bids, and to accept the Bid that will be in the best interest of City of West University Place.

Advertisement Dates:

Wednesday, December 4, 2024
Wednesday, December 11, 2024

SECTION 00 11 16
INVITATION TO BIDDERS

1. Sealed Bids will be received by City of West University Place, Texas on **Friday, January 10, 2025** until **10:00 AM** local time.

2. Sealed bids must be clearly marked "**PW24-18 WASTEWATER TREATMENT PLANT IMPROVEMENTS PHASE 1 – DO NOT OPEN UNTIL 10:00 AM, FRIDAY, JANUARY 10, 2025."** and delivered to the City Secretary's office located at 3800 University Boulevard, West University Place, Texas, to arrive no later than 10:00 A.M., local time, Friday, January 10, 2025. Bids received after that time will not be accepted. The Bids will be evaluated as Competitive Sealed Bids by the procedures described in the Instructions to Bidders.

3. The proposed Work is generally described as follows: improvements to the existing 2.0 million gallon per day Wastewater Treatment Plant (WWTP) located at 2801 N Braeswood Blvd, Houston, TX 77025. Proposed improvements include electrical power service improvements, demolition of existing ground tank, motor control center and control improvements, disinfection improvements, replacement of screw pumps with submersible pumps, a new control building, installation of security cameras, structural improvements, and other associated improvements for successful project completion, as described in the Specifications and shown on the Drawings.

4. A Complete Set of Bid Documents including Plans and Specifications will be available beginning Wednesday, December 4, 2024, online through CivCast at http://www.civcastusa.com/. Search for "**West University Place PW24-18 WWTP Improvements Phase 1**". Bidders must register on this website to view and download specifications, plans, and other related documents for this project. There is NO charge to view or download documents.

5. Representatives of Owner and Engineer will be present at the non-mandatory Pre-Bid Conference to discuss the project. The Pre-Bid Conference will be held on **Wednesday, December 11, 2024**, at **2:00 PM** local time, at the WWTP (2801 N Braeswood Blvd, Houston, TX 77025, Texas).

6. Each Bidder must be licensed under State Law as a General Contractor. Successful bidder shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL91-54), or latest revision.

7. No Bid shall be considered or accepted unless at the time of its filing the same shall be accompanied by (1) a deposit of cash or a certified or cashier's check drawn on a bank or trust company insured by the Federal Deposit Insurance Corporation (FDIC), in an amount equal to five percent (5%) of the amount of the Bid. The check shall be made payable to City of West University Place, Texas. Said deposit shall guarantee that the Contract will be entered into by the successful Bidder if the award is made. Such deposit of cash or certified or cashier's check may be held by the City until the successful Bidder has executed and delivered the Contract Documents, including performance and payment bond, to City of West University Place, Texas and returned or kept in accordance with State Law.

8. In lieu of the cash deposit or certified or cashier's check mentioned above, the Bidder may file a Bid bond in the same amount executed by a corporate surety authorized to execute such bonds in Texas and conditioned as provided by State Law and in the form attached to the Bidding Documents or on file with the Engineer. Bid bond forms enclosed as part of the Bidding Documents must be properly executed at the time Bids are submitted before Bid will be considered. Properly executed Power of Attorney of the corporate surety's agent shall accompany such bond and be attached to the page provided therefore in the Bidding Documents.

9. The Bidder is required to make positive efforts for minority business participation in accordance with State Law. The Bidder shall identify efforts made in this regard and list minority business enterprises that will be used on the project as required in the bidding documents. The Bidder shall comply with the President's Executive Order No. 11246, as amended, which prohibits discrimination in employment regarding race, creed, color, sex or national origin.

10. The Successful Bidder will be required to furnish a Construction Performance Bond and a Construction Payment Bond as security for the faithful performance and the payment of all bills and obligations arising from the performance of the Contract.

11. The Successful Bidder and their subcontractors will be required to conform to the labor standards employment requirements set forth in the Contract Documents.

12. Bids shall be submitted under a condition of irrevocability, except as required by law, for a period of ninety (90) days after Bid opening.

13. The Owner reserves the right to accept or reject any or all Bids, to waive any and all informalities, and to disregard all nonconforming or conditional Bids or counter Bids, and to accept the Bid that will be in the best interest of City of West University Place. The Bids will be evaluated as Competitive Sealed Bids by the procedures described in the Instructions to Bidders.

Advertisement Dates:

Wednesday, December 4, 2024
Wednesday, December 11, 2024

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ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. Addenda--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the bidding Requirements or the proposed Contract Documents.

B. Agreement--The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

C. Bid--The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

D. Bidder--The individual or entity who submits a Bid directly to Owner.

E. Bidding Documents--the Bidding Requirements and the proposed Contract Documents (including all Addenda).

F. Bidding Requirements--The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.

G. Engineer--The individual or entity named as such in the Agreement.

H. Notice of Award--The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

I. Notice to Proceed--A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

J. Owner--The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

K. Subcontractor--An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

L. Registered Plan Holder—The individual or entity who registers with and purchases Contract Documents from the Engineer.

M. Substantial Completion--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.

N. Successful Bidder--The Bidder submitting a responsive Bid to whom Owner makes an award.

O. Supplementary Conditions--That part of the Contract Documents which amends or supplements these General Conditions.

P. Supplier--A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.

Q. Underground Facilities--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

R. Work--The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.01 A Complete Set of Bid Documents including Plans and Specifications will be available beginning Wednesday, December 4, 2024, online through CivCast at http://www.civcastusa.com/. Search for **"West University Place, TX WWTP Improvements Phase 1 PW24-18".** Bidders must register on this website in order to view and/or download specifications, plans, receive addendums, ask questions, and receive other related documents for this project. There is NO charge to view or download documents.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 Bidder understands that the Owner has established the following special qualifications to assist in determining responsibility of bidders for award of the contract, subject to the Instructions to Bidders:

A. *Four Years in Business.* The successful bidder must have been "in existence" and "in full operation" continuously during the four years preceding the date this bid is opened. "In existence" means the bidder was in existence in its present form of business organization. A

bidder remained "in existence" if it just changed its name, or if it merged with or converted to another entity (provided the surviving entity succeeded to all liabilities of the pre-merger entity). A bidder was "in full operation" if it did not declare bankruptcy, make an assignment for the benefit of creditors, enter a receivership or seek reorganization or other relief from creditors. Applicable to prime contractor only.

B. *Surety.* The successful bidder's surety (on each bond, including bid bond) must meet all the criteria shown in the Instructions to Bidders.

C. *Five Projects.* The successful bidder must have commenced at least 5 projects for similar work, and, of the bidder's 10 most-recently awarded or commenced projects for similar work, no more than one was problematic. "Similar work" is defined in the attached Qualification Statement. "Problematic" means that the bidder: (i) was declared to be in default by the owner or a surety, on either a bid or a contract, (ii) finished the work more than 60 days past the required completion date, or (iii) did not substantially finish the work, and there was no express agreement excusing the failure to finish the work.

3.02 The Contractor shall be licensed under State Law as a General Contractor. A copy of the Contractor's License for the Successful Bidder, all Subcontractors of the apparent Successful Bidder, and those Bidders requested by the Owner, shall be filed within five (5) calendar days after notice of selection.

3.03 Successful bidder shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL91-54), or latest revision.

ARTICLE 4 – EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01 *Subsurface and Physical Conditions*

A. The Supplementary Conditions identify:

1. Those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Bidding Documents.

2. Those drawings known to Owner of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except Underground Facilities).

B. Copies of reports and drawings referenced in Paragraph 4.01.A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 5.03 of the General Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 *Underground Facilities*

A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

4.03 *Hazardous Environmental Condition*

A. The Supplementary Conditions identify any reports and drawings known to Owner relating to a Hazardous Environmental Condition identified at the Site.

B. Copies of reports and drawings referenced in Paragraph 4.03.A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 5.06 of the General Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.04 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.05 On request, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.

4.06 A. Reference is made to Article 8 of the General Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of contract documents (other than portions thereof related to price) for such other work.

B. Paragraph 7.12.C of the General Conditions indicates that if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.07 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;

B. visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work;

D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Paragraph 5.03 of the Supplementary Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Paragraph 5.06 of the Supplementary Conditions as containing reliable "technical data";

E. consider the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;

F. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;

H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and

I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 – PRE-BID CONFERENCE AND OPEN HOUSE

5.01 Representatives of Owner and Engineer will be present at the non-mandatory Pre-Bid Conference to discuss the project. The Pre-Bid Conference will be held on **Wednesday, December 11, 2024, at 2:00 PM** local time, at the WWTP (2801 N Braeswood Blvd, Houston, TX 77025, Texas).

5.02 Engineer will transmit to all attending Bidders such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 6 – SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing *through the* CivCast interface. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all Registered Plan Holders on CivCast. Questions received less than ten days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.

ARTICLE 8 – BID SECURITY

8.01 No Bid shall be considered or accepted unless at the time of its filing the same shall be accompanied by (1) a deposit of cash or a certified or cashier's check drawn on a bank or trust company insured by the Federal Deposit Insurance Corporation (FDIC), in an amount equal to five percent (5%) of the amount of the Bid. The check shall be made payable to City of West University Place, Texas. Said deposit shall guarantee that the Contract will be entered into by the successful Bidder if the award is made. Such deposit of cash or certified or cashier's check may be held by the City until the successful Bidder has executed and delivered the Contract Documents, including performance and payment bond, to City of West University Place, Texas and returned or kept in accordance with State Law.

8.02 In lieu of the cash deposit or certified or cashier’s check mentioned above, the Bidder may file a Bid bond in the same amount executed by a corporate surety authorized to execute such bonds in Texas and conditioned as provided by State Law and in the form attached to the Bidding Documents or on file with the Engineer. Bid bond forms enclosed as part of the Bidding Documents must be properly executed at the time Bids are submitted before Bid will be

considered. Properly executed Power of Attorney of the corporate surety's agent shall accompany such bond and be attached to the page provided therefore in the Bidding Documents.

8.03 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Agreement or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned.

8.04 Bid security of other Bidders whom Owner believes do not have a reasonable chance of receiving the award will be returned within seven days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be substantially completed (Contract Time) and ready for final payment are set forth in the Agreement. The Contractor shall commence work on the date specified in the Notice to Proceed, and he shall complete the work within the stipulated Contract Time.

ARTICLE 10 – LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.01 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or

Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute.

12.02 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next most qualified Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 7.07 of the General Conditions.

12.03 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

ARTICLE 13 – PREPARATION OF BID

13.01 *The approved Bid Form is included with the Bidding Documents. All Bids must be submitted on the approved Bid form furnished* in the *Bidding Documents.* DO NOT REMOVE ANY PAGES FROM THE BOUND DOCUMENTS.

13.02 The unit prices for specific items shall reflect all costs associated with furnishing, installing all items of Work as indicated on the Drawings and Technical Specifications, complete, in place and accepted, per the Engineer's Contract Documents, and the requirements of the Texas Commission on Environmental Quality (TCEQ).

13.03 All blank spaces on the Bid Form shall be completed by printing in ink or by typewriter in both words and numerals, and the Bid signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. In case of a conflict between the Price in words and its equivalent shown in numerals, the words will take precedence. BIDS SHALL NOT BE CONDITIONAL, LIMITED OR RESTRICED IN ANY WAY. A Bid price shall be indicated for each unit price item listed therein, or the words "No Bid," "No Change," or "Not Applicable" entered.

13.04 The omission of prices for any item on the Bid form, or the tendering of any unbalanced Bid may be the cause for the rejection of the submitted Bid.

13.05 The estimated quantities contained on the Bid form are for the purpose of comparing Bids. While the quantities are close approximations, they are not guaranteed. Payment will be made on the basis of the Work as actually executed at the unit prices set forth in the executed Agreement and under the provisions of such Agreement.

13.06 There shall be no additional compensation to the Contractor for materials, equipment, or work that is incidental to the successful completion of the Contract. Incidental costs include the costs inherent to the complete installation of those individual items included on the Bid form. For example, those costs associated with temporary electrical services, surveying, staking, deliveries and storage are incidental and defined within the Technical Specifications of the Bidding Documents.

Item values on the Bid form shall be given as figures (i.e. $23,000.00) and in writing (i.e. Twenty-three thousand and no/100's dollars).

13.07 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. Insert the corporate officer's capacity under each signature. The corporate address and state of incorporation shall be shown below the signatures.

13.08 A Bid by a limited liability company shall be executed in the name of the firm by a member in the presence of a witness with signature, and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown below the signature. Affix the limited liability company seal adjacent to the signatures.

13.09 A Bid by an individual or sole proprietorship shall be executed with a signature of the individual/sole proprietor in the presence of a witness with signature. Insert the words "Individual/Sole Proprietor" under the signature and show the Bidder's name and official address. Affix the individual/sole proprietor seal adjacent to the signature.

13.10 A Bid by a partnership shall be executed in the partnership name and signed by all partners (whose title must appear under the signature) in the presence of a witness with signature, accompanied by evidence of authority to sign. The official address of the partnership shall be shown below the signatures. Affix the partnership seal adjacent to each partner signature.

13.11 A Bid by a joint venture shall be executed by each party of the joint venture under their respective seals in a manner appropriate to each such party as described above for each party type. Provide a single signature sheet for each party to the joint venture.

13.12 All names shall be typed or printed in ink below the signatures**.**

13.13 The Bid shall contain an acknowledgment of all Addenda, the numbers of which shall be filled in on the Bid Form.

13.14 The address and telephone number for communication regarding the Bid shall be shown.

13.15 The Bid shall contain evidence of the Bidder's authority and qualification to do business in the state of Texas or covenant to obtain such qualification prior to the award of the Contract. Bidders shall be licensed under State Law as a General Contractor. Bidder's contractor license number shall also be shown on the Bid Form.

13.16 The Bid shall include the evidence of qualifications described in Article 3.

ARTICLE 14 – BASIS OF BID; COMPARISON OF BIDS

14.01 *Unit Price*

A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the Bid schedule.

B. The total of all estimated prices will be the sum of the products of the estimated quantity of each item and the corresponding unit price. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.

14.02 *Allowances*

A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 15 – SUBMITTAL OF BID

15.01 The Bid Form and Bid Bond Form are *included in each copy of the Bidding Documents*. A copy of the *Bid Form is to be completed and submitted with the Bid security* (in *the* form of a Bid Bond).

15.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in an opaque sealed envelope with the Project title, the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, sealed Bids shall be sent to the attention of Sealed Bid to City Secretary, City of West University Place, TX, 3800 University Boulevard, West University Place, TX 77005. Envelopes shall be marked ***"PW24-18 WASTEWATER TREATMENT PLANT IMPROVEMENTS PHASE 1 – DO NOT OPEN UNTIL 10:00 AM, FRIDAY, JANUARY 10, 2025."***

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

16.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.

16.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

17.01 Bids will be opened at the time and place indicated in the Advertisement or Invitation to Bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

17.02 Bids from non-qualified bidders will not be opened.

17.03 Bidders may be present at the opening of bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

19.04 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work in accordance with the Contract Documents.

19.06 If the Contract is to be awarded, Owner will award the Contract to the Bidder whose Bid is in the best interests of the Project.

19.07 If the contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within forty-five days after the day of the Bid Opening.

19.08 Successful Bidder will be required to provide completed Form 1295 to the Owner.

ARTICLE 20 – CONTRACT SECURITY AND INSURANCE

20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such bonds.

ARTICLE 21 – SIGNING OF AGREEMENT

21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement along with the other Contract Documents which are identified in the Agreement as attached thereto. Within 15 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner. Within ten days thereafter, Owner shall deliver one fully signed counterpart to Successful Bidder with a complete set of the Drawings with appropriate identification.

ARTICLE 22 – SALES AND USE TAXES

22.01 Owner is exempt from State of Texas sales and use taxes on materials and equipment to be incorporated in the work. Said taxes shall not be included in the bid. Refer to paragraph SC-6.10 of the supplementary conditions for additional information.

END OF SECTION

BID FORM
FOR
Wastewater Treatment Plant Improvements Phase 1
City of West University Place, Texas

Bidder: _____ Date_____
(Name of Contractor)

_____
(Address)

_____ _____
(Phone) (Fax)

ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

City of West University Place
Attention: City Secretary
3800 University Boulevard
West University Place, TX 77005

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for ninety (90) calendar days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

2.02 Bidder will sign and submit the Agreement with the Bonds and other required documents within fifteen (15) calendar days after the date of Owner's Notice of Award.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Number	Addendum Date

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Section 4.02 of Specification 00 21 13 as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Section 4.03 of Specification 00 21 13 as containing reliable "technical data."

E. Bidder has considered the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.in the Contract Documents.

G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):
*WWTP:Wastewater Treatment Plant Improvements Plan Set
*CIVIL:Wastewater Treatment Plant Improvements Civil Sitework Plan Set
Spec Item: 01 22 00

BASE BID

No.	Plan Set	Name of Pay Item with Unit Price in Words	Est. Quantity	Unit	Unit Bid Price	Amount Bid
1	General	Mobilization dollars and cents per unit	1	LS	$	$
2	Vol I: Civil	Temporary Erosion, Sediment, and Water Pollution Prevention dollars and cents per unit	1	LS	$	$
3	Vol I: Civil	Site Civil Work dollars and cents per unit	1	LS	$	$
4	Vol I: Civil	Demolition dollars and cents per unit	1	LS	$	$
5	Vol III: WWTP	Influent Lift Station dollars and cents per unit	1	LS	$	$
6	Vol III: WWTP	Consolidated Operations and Maintenance Manual dollars and cents per unit	1	LS	$	$
7	Vol III: WWTP	WWTP Structural Improvements dollars and cents per unit	1	LS	$	$
8	Vol II: Building	Control Building dollars and cents per unit	1	LS	$	$
9	Vol III: WWTP	Security Cameras dollars and cents per unit	1	LS	$	$

Item No.	Spec. Item	Name of Pay Item with Unit Price in Words	Est. Quantity	Unit	Unit Bid Price	Amount Bid
10	Vol III: WWTP Vol II: Building	System Integrator Allowance dollars and cents per unit	1	LS	$	$
11	Vol III: WWTP	Integration of Existing Chlorine Gas System to Proposed Equipment dollars and cents per unit	1	LS	$	$
12	Vol III: WWTP	Site Electrical, Instrumentation, and Control dollars and cents per unit	1	LS	$	$
13	Vol III: WWTP	Electrical Power Service Improvements dollars and cents per unit	1	LS	$	$
14	Vol III: WWTP	CenterPoint Energy Allowance dollars and cents per unit	1	LS	$ 75,000.00	$ 75,000.00
15	Vol III: WWTP	Trench Safety dollars and cents per unit	1	LS	$	$

TOTAL BASE BID ITEMS 1 through 15 (words and figures)

_____ **DOLLARS**

_____ **CENTS** **$** _____

ADDITIVE ALTERNATE BID

No.	Plan Set	Name of Pay Item with Unit Price in Words	Est. Quantity	Unit	Unit Bid Price	Amount Bid
A-1	Vol III: WWTP	Disinfection System, Alternate Base Bid Item 11 dollars and cents per unit	1	LS	$	$
A-2	Vol III: WWTP	Removeable Flood Protection Walls dollars and cents per unit	60	LF	$	$
A-3	Vol III: WWTP	Vertical Crack Injection for Existing Concrete dollars and cents per unit	2,000	LF	$	$
A-4	Vol III: WWTP	Concrete Joint Repair for Existing Concrete dollars and cents per unit	1,500	LF	$	$
A-5	Vol III: WWTP	Concrete Mortar Repair for Existing Concrete dollars and cents per unit	75	CF	$	$

TOTAL ADDITIVE ALTERNATE BID For All Items (words and figures)

_____ **DOLLARS**

_____ **CENTS** **$** _____

BID SUMMARY FOR
City of West University Place, Texas
Wastewater Treatment Plant Improvements Phase 1

TOTAL FOR BASE BIDS	$ _____
TOTAL FOR ADDITIVE ALTERNATE BID	$ _____
TOTAL FOR BASE BIDS AND ADDITIVE ALTERNATE BID	$ _____

5.02 Unit Prices have been computed in accordance with Section 01 22 00.

5.03 For Unit Price bid items, Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Waste water Treat For Lump Sum bid items, Bidder acknowledges that amounts bid shall be full compensation for the associated work and changes in the final payment amount may only by change order as provided in for in the Contract.

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Article 15 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.01 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security in the form of a certified or cashier's check or a Bid Bond in an amount of five percent of the Bidder's maximum bid price, made payable to the Owner, in accordance with Article 8 of the Instructions to Bidders.

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

SUBMITTED on _____

Signed: _____

Company: _____

Address: _____

Telephone: _____

Fax: _____

Submitted by: _____

Doing Business As: _____

☐ an individual
☐ a partnership
☐ a corporation
☐ a joint venture
☐ an LLC

SEAL:
(if Bidder is a corporation)

No specifications on this page for formatting purposes.

BID SECURITY FORM

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:
City of West University Place, Texas
3800 University Boulevard, West University Place, TX 77005

BID
Bid Due Date: Wednesday July 17, 2024
Description: Wastewater Treatment Plant Improvements

BOND
Bond
Number:
Date *(Not earlier than Bid due date)*:
Penal sum _____ $ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
_____	_____
Title	Title

Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

QUALIFICATION STATEMENT

Owner: City of West University Place, Texas

Project: Wastewater Treatment Plant Improvements Phase 1

Similar Work (definition): The project includes electrical power service improvements, demolition of existing ground tank, motor control center and control improvements, disinfection improvements, replacement of screw pumps with submersible pumps, a new control building, installation of security cameras, structural improvements, and other associated improvements for successful project completion, as described in the Specifications and shown on the Drawings.

(NOTE: If any bid is to be made jointly by two or more entities, each entity must complete a separate statement.)

The undersigned Bidder certifies the following, under oath:

A. **GENERAL**

Full Legal Name of Bidder:

Check one: ( ) Partnership ( ) Joint Venture ( ) Corporation
( ) Other:_____

Address:

Telephone: **Fax:**

B. ORGANIZATIONAL BACKGROUND

1. If the Bidder is a PARTNERSHIP or JOINT VENTURE

   a. Date of organization:

   b. State whether partnership is general or limited:

c. List all general partners and any limited partners owning 10% or more:
Name Address Phone % owned

2. If Bidder is a CORPORATION or LLC

a. Date of incorporation or formation:

b. State of incorporation or formation:

c. Charter/permit number:

d. Principal place(s) of business:

e. Other state(s) in which firm is authorized to do business:

f. Officers

i. *President:*

ii. *Vice President(s):*

iii. *Secretary:*

iv. *Treasurer:*

v. *Other:*

g. List all persons and entities owning 10% or more of the firm:

Name Address Telephone % owned

3. If the Bidder is *other than a partnership, LLC or corporation*:
a. Describe the organization:

b. List all principals of the organization:

Name *Address* *Telephone* *Title*

c. Date and manner of the organization's formation:

4. How long has the Bidder done business under its present name and at its present address?

a. Under what other or former names and addresses has the Bidder operated in the past five years?

Name:

Address:

Years:

b. Has the Bidder ever defaulted, declared bankruptcy, or undergone reorganization procedures?

_____Yes _____No

If "yes", attach details: list of creditors, amounts owed each, amounts repaid, resolution of proceedings, etc.

c. Has a predecessor of the Bidder defaulted, declared bankruptcy, or undergone reorganization procedures?

_____Yes _____No

If "yes", attach details, as above.

d. Does the Bidder presently have outstanding claims pending against it?

_____Yes _____No

If "yes", attach details, as above.

e. Has the Bidder been involved in litigation within the past five years, or is it currently involved in litigation?

_____Yes _____No

If "yes", attach details, as above.

f. Has an officer or principal of the Bidder ever engaged in any of the activities or had claims against it, him or her as described in this Part B?

_____Yes _____No

If "yes", attach details, as above.

5. Has Bidder ever changed its name, changed its form of organization or merged?

_____Yes _____No

If “yes,” attach a detailed description of any name changes, changes in entity form or mergers, including documentary proof that any surviving entity succeeded to all liabilities of the pre-existing entities.

C. SIMILAR WORK. (Note: "similar work" is defined above.)

1. How many years experience in “similar work” has the Bidder had?

   a. As a general contractor: _____years

   b. As a subcontractor:_____ years

2. Has the Bidder ever failed to complete a contract, forfeited a bid bond/proposal guaranty, had liquidated damages withheld from its total compensation due on a contract (in excess of 1% of total contract payments), or refused to enter into contract for work awarded to it?

   _____Yes _____No

   If "yes", attach details: (a) name of project, (b) contract amount, (c) type of work, (d) name and addresses of: (I) project engineer, (ii) contractor, and (iii) owner, (e) when, (f) where, and (g) why.

3. Attached is a "Project Sheet" (form attached) for each of the Bidder's five mostrecently commenced projects for “similar work” (including any projects for which a contract was awarded but the work was not started).

4. Bidder’s Surety

   Name and address of surety company:

   Authorized to do surety bonds in Texas?

   Maximum amount of bond authorized to issue:

D. CERTIFICATION. The Bidder certifies, under oath, that all information contained in or attached to this Statement is current, correct, and complete. Any person, depository, agency, or other entity named in the Statement or attachments is authorized to supply Owner or its representative with any information necessary to verify information from this Statement.

_____

(print or type bidder's name)

By:*(authorized signature)*_____,

Name:_____,Title:_____.

Date:_____.

STATE OF TEXAS §

COUNTY OF HARRIS §

SWORN TO AND SUBSCRIBED before me on the___ day of _____, _____

(SEAL)

Notary Public My Commission Expires:

"PROJECT SHEET" No. ___

(For: _____, Bidder)

Name of project:

Type of work:

Location (city, county, state):

Bidder's compensation:

Required completion date:

Date completed:

Name and address and telephone of project engineer or architect:

Name, address, and telephone of owner:

Owner's principal project representative (name):

Was Bidder declared to be in default by the owner or the surety?

_____*Yes* _____*No*

City of West University Place, Texas PW24-18 Wastewater Treatment Plant Improvements Phase 1

NON-COLLUSION AFFIDAVIT OF BIDDER

State of_____ County of_____
_____, being first duly sworn, deposes and says that:

1. He is _____ of _____, the Bidder that has submitted the attached Bid;

2. He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;

3. Such Bid is genuine and is not a collusive or sham Bid;

4. Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from Bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy connivance or unlawful agreement any advantage against the City of West University Place, Texas (Local Public Agency) or any person interested in the proposed Contract; and

5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

(Signed)_____

_____
Title

Subscribed and sworn to before me this
_____ day of _____, _____

_____
Title

My Commission Expires _____

NON-COLLUSION AFFIDAVIT OF SUBCONTRACTOR(S)

State of _____ County of _____
_____, being first duly sworn, deposes and says that:

1. He is _____ of _____, hereinafter referred to as the "Subcontractor";

2. He is fully informed respecting the preparation and contents of the Subcontractor's Proposal submitted by the Subcontractor to _____
_____, the Contractor for certain work in connection with the Wastewater Treatment Plant Improvements _____
Contract pertaining to the Project in City of West University Place, Texas (Owner or County and State);

3. Such Subcontractor's Proposal is genuine and is not a collusive or sham proposal;

4. Neither the Subcontractor nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Proposal in connection with such Contract or to refrain from submitting a Proposal in connection with such Contract, or has in any manner, directly or indirectly, sought by unlawful agreement or connivance with any other Bidder, firm or person to fix the price or prices in said Contractor's Proposal, or to fix any overhead, profit or cost element of the price or prices in said Contractor's Proposal, or to secure through collusion, conspiracy connivance or unlawful agreement any advantage against the City of West University Place, Texas (Local Public Agency) or any person interested in the proposed Contract; and

5. The price or prices quoted in the Subcontractor's Proposal are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

(Signed) _____

_____
Title

Subscribed and sworn to before me this
_____ day of _____, _____

_____
Title

My Commission Expires _____

CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. *See* Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY
Date Received

1 **Name of vendor who has a business relationship with local governmental entity.**

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.** (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 **Name of local government officer about whom the information is being disclosed.**

_____
Name of Officer

4 **Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.**

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ Yes ☐ No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No

5 **Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.**

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

_____ _____
Signature of vendor doing business with the governmental entity Date

Form provided by Texas Ethics Commission www.ethics.state.tx.us Revised 11/30/2015

CONFLICT OF INTEREST QUESTIONNAIRE
For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

(A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;

(B) a transaction conducted at a price and subject to terms available to the public; or

(C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

***

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds $2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than $100 in the 12-month period preceding the date the officer becomes aware that:

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.

Form provided by Texas Ethics Commission www.ethics.state.tx.us Revised 11/30/2015

Form **W-9**
(Rev. October 2007)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Give form to the requester. Do not send to the IRS.

Print or type See **Specific Instructions** on page 2.

Name (as shown on your income tax return)

Business name, if different from above

Check appropriate box: ☐ Individual/Sole proprietor ☐ Corporation ☐ Partnership
☐ Limited liability company. Enter the tax classification (D=disregarded entity, C=corporation, P=partnership) ▶ .....
☐ Other (see instructions) ▶

☐ Exempt payee

Address (number, street, and apt. or suite no.)

Requester's name and address (optional)

City, state, and ZIP code

List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on Line 1 to avoid backup withholding. For individuals, this is your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN* on page 3.

Note. If the account is in more than one name, see the chart on page 4 for guidelines on whose number to enter.

Social security number

or

Employer identification number

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me), and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding, and
3. I am a U.S. citizen or other U.S. person (defined below).

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the Certification, but you must provide your correct TIN. See the instructions on page 4.

Sign Here **Signature of U.S. person** ▶ **Date** ▶

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Purpose of Form

A person who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) to report, for example, income paid to you, real estate transactions, mortgage interest you paid, acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA.

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN to the person requesting it (the requester) and, when applicable, to:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),
2. Certify that you are not subject to backup withholding, or
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income.

Note. If a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:

- An individual who is a U.S. citizen or U.S. resident alien,
- A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States,
- An estate (other than a foreign estate), or
- A domestic trust (as defined in Regulations section 301.7701-7).

Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax on any foreign partners' share of income from such business. Further, in certain cases where a Form W-9 has not been received, a partnership is required to presume that a partner is a foreign person, and pay the withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid withholding on your share of partnership income.

The person who gives Form W-9 to the partnership for purposes of establishing its U.S. status and avoiding withholding on its allocable share of net income from the partnership conducting a trade or business in the United States is in the following cases:

- The U.S. owner of a disregarded entity and not the entity,

Cat. No. 10231X Form **W-9** (Rev. 10-2007)

- The U.S. grantor or other owner of a grantor trust and not the trust, and
- The U.S. trust (other than a grantor trust) and not the beneficiaries of the trust.

Foreign person. If you are a foreign person, do not use Form W-9. Instead, use the appropriate Form W-8 (see Publication 515, Withholding of Tax on Nonresident Aliens and Foreign Entities).

Nonresident alien who becomes a resident alien. Generally, only a nonresident alien individual may use the terms of a tax treaty to reduce or eliminate U.S. tax on certain types of income. However, most tax treaties contain a provision known as a "saving clause." Exceptions specified in the saving clause may permit an exemption from tax to continue for certain types of income even after the payee has otherwise become a U.S. resident alien for tax purposes.

If you are a U.S. resident alien who is relying on an exception contained in the saving clause of a tax treaty to claim an exemption from U.S. tax on certain types of income, you must attach a statement to Form W-9 that specifies the following five items:

1. The treaty country. Generally, this must be the same treaty under which you claimed exemption from tax as a nonresident alien.

2. The treaty article addressing the income.

3. The article number (or location) in the tax treaty that contains the saving clause and its exceptions.

4. The type and amount of income that qualifies for the exemption from tax.

5. Sufficient facts to justify the exemption from tax under the terms of the treaty article.

Example. Article 20 of the U.S.-China income tax treaty allows an exemption from tax for scholarship income received by a Chinese student temporarily present in the United States. Under U.S. law, this student will become a resident alien for tax purposes if his or her stay in the United States exceeds 5 calendar years. However, paragraph 2 of the first Protocol to the U.S.-China treaty (dated April 30, 1984) allows the provisions of Article 20 to continue to apply even after the Chinese student becomes a resident alien of the United States. A Chinese student who qualifies for this exception (under paragraph 2 of the first protocol) and is relying on this exception to claim an exemption from tax on his or her scholarship or fellowship income would attach to Form W-9 a statement that includes the information described above to support that exemption.

If you are a nonresident alien or a foreign entity not subject to backup withholding, give the requester the appropriate completed Form W-8.

What is backup withholding? Persons making certain payments to you must under certain conditions withhold and pay to the IRS 28% of such payments. This is called "backup withholding." Payments that may be subject to backup withholding include interest, tax-exempt interest, dividends, broker and barter exchange transactions, rents, royalties, nonemployee pay, and certain payments from fishing boat operators. Real estate transactions are not subject to backup withholding.

You will not be subject to backup withholding on payments you receive if you give the requester your correct TIN, make the proper certifications, and report all your taxable interest and dividends on your tax return.

Payments you receive will be subject to backup withholding if:

1. You do not furnish your TIN to the requester,

2. You do not certify your TIN when required (see the Part II instructions on page 3 for details),

3. The IRS tells the requester that you furnished an incorrect TIN,

4. The IRS tells you that you are subject to backup withholding because you did not report all your interest and dividends on your tax return (for reportable interest and dividends only), or

5. You do not certify to the requester that you are not subject to backup withholding under 4 above (for reportable interest and dividend accounts opened after 1983 only).

Certain payees and payments are exempt from backup withholding. See the instructions below and the separate Instructions for the Requester of Form W-9.

Also see *Special rules for partnerships* on page 1.

Penalties

Failure to furnish TIN. If you fail to furnish your correct TIN to a requester, you are subject to a penalty of $50 for each such failure unless your failure is due to reasonable cause and not to willful neglect.

Civil penalty for false information with respect to withholding. If you make a false statement with no reasonable basis that results in no backup withholding, you are subject to a $500 penalty.

Criminal penalty for falsifying information. Willfully falsifying certifications or affirmations may subject you to criminal penalties including fines and/or imprisonment.

Misuse of TINs. If the requester discloses or uses TINs in violation of federal law, the requester may be subject to civil and criminal penalties.

Specific Instructions

Name

If you are an individual, you must generally enter the name shown on your income tax return. However, if you have changed your last name, for instance, due to marriage without informing the Social Security Administration of the name change, enter your first name, the last name shown on your social security card, and your new last name.

If the account is in joint names, list first, and then circle, the name of the person or entity whose number you entered in Part I of the form.

Sole proprietor. Enter your individual name as shown on your income tax return on the "Name" line. You may enter your business, trade, or "doing business as (DBA)" name on the "Business name" line.

Limited liability company (LLC). Check the "Limited liability company" box only and enter the appropriate code for the tax classification ("D" for disregarded entity, "C" for corporation, "P" for partnership) in the space provided.

For a single-member LLC (including a foreign LLC with a domestic owner) that is disregarded as an entity separate from its owner under Regulations section 301.7701-3, enter the owner's name on the "Name" line. Enter the LLC's name on the "Business name" line.

For an LLC classified as a partnership or a corporation, enter the LLC's name on the "Name" line and any business, trade, or DBA name on the "Business name" line.

Other entities. Enter your business name as shown on required federal tax documents on the "Name" line. This name should match the name shown on the charter or other legal document creating the entity. You may enter any business, trade, or DBA name on the "Business name" line.

Note. You are requested to check the appropriate box for your status (individual/sole proprietor, corporation, etc.).

Exempt Payee

If you are exempt from backup withholding, enter your name as described above and check the appropriate box for your status, then check the "Exempt payee" box in the line following the business name, sign and date the form.

Generally, individuals (including sole proprietors) are not exempt from backup withholding. Corporations are exempt from backup withholding for certain payments, such as interest and dividends.

Note. If you are exempt from backup withholding, you should still complete this form to avoid possible erroneous backup withholding.

The following payees are exempt from backup withholding:

1. An organization exempt from tax under section 501(a), any IRA, or a custodial account under section 403(b)(7) if the account satisfies the requirements of section 401(f)(2),

2. The United States or any of its agencies or instrumentalities,

3. A state, the District of Columbia, a possession of the United States, or any of their political subdivisions or instrumentalities,

4. A foreign government or any of its political subdivisions, agencies, or instrumentalities, or

5. An international organization or any of its agencies or instrumentalities.

Other payees that may be exempt from backup withholding include:

6. A corporation,

7. A foreign central bank of issue,

8. A dealer in securities or commodities required to register in the United States, the District of Columbia, or a possession of the United States,

9. A futures commission merchant registered with the Commodity Futures Trading Commission,

10. A real estate investment trust,

11. An entity registered at all times during the tax year under the Investment Company Act of 1940,

12. A common trust fund operated by a bank under section 584(a),

13. A financial institution,

14. A middleman known in the investment community as a nominee or custodian, or

15. A trust exempt from tax under section 664 or described in section 4947.

The chart below shows types of payments that may be exempt from backup withholding. The chart applies to the exempt payees listed above, 1 through 15.

IF the payment is for . . .	THEN the payment is exempt for . . .
Interest and dividend payments	All exempt payees except for 9
Broker transactions	Exempt payees 1 through 13. Also, a person registered under the Investment Advisers Act of 1940 who regularly acts as a broker
Barter exchange transactions and patronage dividends	Exempt payees 1 through 5
Payments over $600 required to be reported and direct sales over $5,000[1]	Generally, exempt payees 1 through 7[2]

[1] See Form 1099-MISC, Miscellaneous Income, and its instructions.

[2] However, the following payments made to a corporation (including gross proceeds paid to an attorney under section 6045(f), even if the attorney is a corporation) and reportable on Form 1099-MISC are not exempt from backup withholding: medical and health care payments, attorneys' fees, and payments for services paid by a federal executive agency.

Part I. Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. If you are a resident alien and you do not have and are not eligible to get an SSN, your TIN is your IRS individual taxpayer identification number (ITIN). Enter it in the social security number box. If you do not have an ITIN, see *How to get a TIN* below.

If you are a sole proprietor and you have an EIN, you may enter either your SSN or EIN. However, the IRS prefers that you use your SSN.

If you are a single-member LLC that is disregarded as an entity separate from its owner (see *Limited liability company (LLC)* on page 2), enter the owner's SSN (or EIN, if the owner has one). Do not enter the disregarded entity's EIN. If the LLC is classified as a corporation or partnership, enter the entity's EIN.

Note. See the chart on page 4 for further clarification of name and TIN combinations.

How to get a TIN. If you do not have a TIN, apply for one immediately. To apply for an SSN, get Form SS-5, Application for a Social Security Card, from your local Social Security Administration office or get this form online at *www.ssa.gov*. You may also get this form by calling 1-800-772-1213. Use Form W-7, Application for IRS Individual Taxpayer Identification Number, to apply for an ITIN, or Form SS-4, Application for Employer Identification Number, to apply for an EIN. You can apply for an EIN online by accessing the IRS website at *www.irs.gov/businesses* and clicking on Employer Identification Number (EIN) under Starting a Business. You can get Forms W-7 and SS-4 from the IRS by visiting *www.irs.gov* or by calling 1-800-TAX-FORM (1-800-829-3676).

If you are asked to complete Form W-9 but do not have a TIN, write "Applied For" in the space for the TIN, sign and date the form, and give it to the requester. For interest and dividend payments, and certain payments made with respect to readily tradable instruments, generally you will have 60 days to get a TIN and give it to the requester before you are subject to backup withholding on payments. The 60-day rule does not apply to other types of payments. You will be subject to backup withholding on all such payments until you provide your TIN to the requester.

Note. Entering "Applied For" means that you have already applied for a TIN or that you intend to apply for one soon.

Caution: *A disregarded domestic entity that has a foreign owner must use the appropriate Form W-8.*

Part II. Certification

To establish to the withholding agent that you are a U.S. person, or resident alien, sign Form W-9. You may be requested to sign by the withholding agent even if items 1, 4, and 5 below indicate otherwise.

For a joint account, only the person whose TIN is shown in Part I should sign (when required). Exempt payees, see *Exempt Payee* on page 2.

Signature requirements. Complete the certification as indicated in 1 through 5 below.

1. Interest, dividend, and barter exchange accounts opened before 1984 and broker accounts considered active during 1983. You must give your correct TIN, but you do not have to sign the certification.

2. Interest, dividend, broker, and barter exchange accounts opened after 1983 and broker accounts considered inactive during 1983. You must sign the certification or backup withholding will apply. If you are subject to backup withholding and you are merely providing your correct TIN to the requester, you must cross out item 2 in the certification before signing the form.

3. Real estate transactions. You must sign the certification. You may cross out item 2 of the certification.

4. Other payments. You must give your correct TIN, but you do not have to sign the certification unless you have been notified that you have previously given an incorrect TIN. "Other payments" include payments made in the course of the requester's trade or business for rents, royalties, goods (other than bills for merchandise), medical and health care services (including payments to corporations), payments to a nonemployee for services, payments to certain fishing boat crew members and fishermen, and gross proceeds paid to attorneys (including payments to corporations).

5. Mortgage interest paid by you, acquisition or abandonment of secured property, cancellation of debt, qualified tuition program payments (under section 529), IRA, Coverdell ESA, Archer MSA or HSA contributions or distributions, and pension distributions. You must give your correct TIN, but you do not have to sign the certification.

What Name and Number To Give the Requester

For this type of account:	Give name and SSN of:
1. Individual	The individual
2. Two or more individuals (joint account)	The actual owner of the account or, if combined funds, the first individual on the account [1]
3. Custodian account of a minor (Uniform Gift to Minors Act)	The minor [2]
4. a. The usual revocable savings trust (grantor is also trustee)	The grantor-trustee [1]
b. So-called trust account that is not a legal or valid trust under state law	The actual owner [1]
5. Sole proprietorship or disregarded entity owned by an individual	The owner [3]
For this type of account:	**Give name and EIN of:**
6. Disregarded entity not owned by an individual	The owner
7. A valid trust, estate, or pension trust	Legal entity [4]
8. Corporate or LLC electing corporate status on Form 8832	The corporation
9. Association, club, religious, charitable, educational, or other tax-exempt organization	The organization
10. Partnership or multi-member LLC	The partnership
11. A broker or registered nominee	The broker or nominee
12. Account with the Department of Agriculture in the name of a public entity (such as a state or local government, school district, or prison) that receives agricultural program payments	The public entity

[1] List first and circle the name of the person whose number you furnish. If only one person on a joint account has an SSN, that person's number must be furnished.

[2] Circle the minor's name and furnish the minor's SSN.

[3] You must show your individual name and you may also enter your business or "DBA" name on the second name line. You may use either your SSN or EIN (if you have one), but the IRS encourages you to use your SSN.

[4] List first and circle the name of the trust, estate, or pension trust. (Do not furnish the TIN of the personal representative or trustee unless the legal entity itself is not designated in the account title.) Also see *Special rules for partnerships* on page 1.

Note. If no name is circled when more than one name is listed, the number will be considered to be that of the first name listed.

Secure Your Tax Records from Identity Theft

Identity theft occurs when someone uses your personal information such as your name, social security number (SSN), or other identifying information, without your permission, to commit fraud or other crimes. An identity thief may use your SSN to get a job or may file a tax return using your SSN to receive a refund.

To reduce your risk:

- Protect your SSN,
- Ensure your employer is protecting your SSN, and
- Be careful when choosing a tax preparer.

Call the IRS at 1-800-829-1040 if you think your identity has been used inappropriately for tax purposes.

Victims of identity theft who are experiencing economic harm or a system problem, or are seeking help in resolving tax problems that have not been resolved through normal channels, may be eligible for Taxpayer Advocate Service (TAS) assistance. You can reach TAS by calling the TAS toll-free case intake line at 1-877-777-4778 or TTY/TDD 1-800-829-4059.

Protect yourself from suspicious emails or phishing schemes. Phishing is the creation and use of email and websites designed to mimic legitimate business emails and websites. The most common act is sending an email to a user falsely claiming to be an established legitimate enterprise in an attempt to scam the user into surrendering private information that will be used for identity theft.

The IRS does not initiate contacts with taxpayers via emails. Also, the IRS does not request personal detailed information through email or ask taxpayers for the PIN numbers, passwords, or similar secret access information for their credit card, bank, or other financial accounts.

If you receive an unsolicited email claiming to be from the IRS, forward this message to *phishing@irs.gov*. You may also report misuse of the IRS name, logo, or other IRS personal property to the Treasury Inspector General for Tax Administration at 1-800-366-4484. You can forward suspicious emails to the Federal Trade Commission at: *spam@uce.gov* or contact them at *www.consumer.gov/idtheft* or 1-877-IDTHEFT(438-4338).

Visit the IRS website at *www.irs.gov* to learn more about identity theft and how to reduce your risk.

Privacy Act Notice

Section 6109 of the Internal Revenue Code requires you to provide your correct TIN to persons who must file information returns with the IRS to report interest, dividends, and certain other income paid to you, mortgage interest you paid, the acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA, or Archer MSA or HSA. The IRS uses the numbers for identification purposes and to help verify the accuracy of your tax return. The IRS may also provide this information to the Department of Justice for civil and criminal litigation, and to cities, states, the District of Columbia, and U.S. possessions to carry out their tax laws. We may also disclose this information to other countries under a tax treaty, to federal and state agencies to enforce federal nontax criminal laws, or to federal law enforcement and intelligence agencies to combat terrorism.

You must provide your TIN whether or not you are required to file a tax return. Payers must generally withhold 28% of taxable interest, dividend, and certain other payments to a payee who does not give a TIN to a payer. Certain penalties may also apply.

CERTIFICATE OF INTERESTED PARTIES — FORM 1295

Complete Nos. 1 - 4 and 6 if there are interested parties. Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.	**OFFICE USE ONLY**
1 Name of business entity filing form, and the city, state and country of the business entity's place of business.	
2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.	

3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the goods or services to be provided under the contract.

4 Name of Interested Party	City, State, Country (place of business)	Nature of Interest (check applicable)	
		Controlling	Intermediary

5 Check only if there is NO Interested Party. ☐

6 **AFFIDAVIT**

I swear, or affirm, under penalty of perjury, that the above disclosure is true and correct.

_____
Signature of authorized agent of contracting business entity

AFFIX NOTARY STAMP / SEAL ABOVE

Sworn to and subscribed before me, by the said _____, this the _____ day of _____, 20 _____, to certify which, witness my hand and seal of office.

_____ _____ _____
Signature of officer administering oath | Printed name of officer administering oath | Title of officer administering oath

ADD ADDITIONAL PAGES AS NECESSARY

Form provided by Texas Ethics Commission www.ethics.state.tx.us Adopted 10/5/2015

Harris County Building Construction
Prevailing Wage Rates
Quarter 4 of 2024

Worker Classifications		Base Rate	Fringe Benefit	Wage Total
Asbestos Worker/Heat and Frost Insulator (Duct, Pipe and Mechanical System Insulation)	1 Journeyman / 1 Apprentice	$28.35	$16.02	$44.37
Acoustical Ceiling Mechanic		$17.27	$3.98	$21.25
Boilermaker	5 Journeyman / 1 Apprentice	$37.00	$24.64	$61.64
Bricklayer	1 Journeyman / 3 Mason Tenders Brick	$18.87	$0.00	$18.87
Carpenter (Excludes Acoustical Ceiling Installation, Drywall Hanging, Form Work and Metal Stud Installation)	2 Journeyman / 1 Apprentice	$25.86	$9.08	$34.94
Caulker		$15.36	$0.00	$15.36
Cement Mason/Concrete Finisher	1 Journeyman/ 3 Mason Tenders Cement	$15.00	$0.00	$15.00
Drywall Finisher/Taper	1 Journeyman/ 3 Helpers $15.00	$16.27	$3.66	$19.93
Drywall Hanger (includes Metal Studs Installer)	1 Journeyman/ 3 Helpers $15.00	$17.44	$3.93	$21.37
Electrician (Excludes Low Voltage Wiring and Installation of Alarms	3 Journeyman / 2 Apprentice	$34.50	$10.41	$44.91
Electrician (Alarm Installation Only)-APPRENTICES (see definitions)-Electrician (Alarm Installation Only) - 1 Journeyman/1 Apprentice APPRENTICES (see definitions)	1 Journeyman/1 Apprentice	$17.97	$3.37	$21.34
Electrician (Low Voltage Wiring Only)-HELPER (see definitions)	1 Journeyman/3 Helper $15.00	$18.00	$1.68	$19.68
Elevator Mechanic	1 Journeyman / 1 Apprentice	$51.32	$37.89	$89.21
Floor Layer/Carpet Layer-Floor Layer/Carpet Layer - 1 Journeyman / 3 Helpers $15.00	1 Journeyman / 3 Helpers $15.00	$20.00	$0.00	$20.00
Form Builder/Formsetter	1 Journeyman/ 3 Helpers $15.00	$15.00	$0.00	$15.00
Glazier	1 Journeyman/ 3 Helpers $15.00	$23.27	$7.12	$30.39
Insulator (Batt and Foam)	1 Journeyman/ 3 Helpers $15.00	$15.00	$0.73	$15.73
Ironworker - Reinforcing	1 Journeyman/ 3 Helpers $15.00	$15.00	$0.00	$15.00
Ironworker - Structural -Ironworker - Structural - 1 Journeyman/ 3 Helpers $15.00	1 Journeyman/ 3 Helpers $15.00	$27.51	$8.13	$35.64
Ironworker- Ornamental-Ironworker- Ornamental - 1 Journeyman/ 3 Helpers $15.00	1 Journeyman/ 3 Helpers $15.00	$27.51	$8.13	$35.64
Laborer-Common Laborer-Common Laborer - Laborer -		$15.00	$0.00	$15.00
Laborer- Landscape and Irrigation		$15.00	$0.00	$15.00
Laborer- Mason Tender Brick (Bricklayer's Helper)		$15.00	$0.00	$15.00
Laborer-Mason Tender Cement- (Concrete Mason's / Concrete Finisher's Helper)		$15.00	$0.00	$15.00
Laborer-Pipelayer		$15.00	$0.00	$15.00
Laborer- Roof Tearoff		$15.00	$0.00	$15.00
Lather	1 Journeyman/ 3 Helpers $15.00	$19.73	$0.00	$19.73
Operator- Backhoe, Excavator, Trackhoe		$15.00	$0.00	$15.00
Operator- Bobcat/Skid, Steer/Skid Loader		$15.00	$0.00	$15.00
Operator- Bulldozer		$22.75	$0.00	$22.75
Operator- Crane		$34.85	$9.85	$44.70
Operator- Drill		$16.22	$0.34	$16.56
Operator- Forklift		$16.00	$0.00	$16.00
Operator- Grader/Blade		$15.00	$0.00	$15.00
Operator- Loader		$15.00	$0.94	$15.94
Operator- Mechanic		$17.52	$3.33	$20.85
Operator- Paver (Asphalt, Aggragate, and Concrete)		$16.03	$0.00	$16.03
Operator- Roller		$16.00	$0.00	$16.00
Painter (Brush, Roll, Spray)	1 Journeyman/ 3 Helpers $15.00	$17.24	$4.41	$21.65
Pipefitters (Includes HVAC Pipe Installation)	1 Journeyman/ 1 Apprentice	$38.31	$12.61	$50.92
Plasterer	1 Journeyman / 3 Plaster Tenders	$31.34	$10.30	$41.64
Plumbers (Excludes HVAC Installation)	3 Journeyman / 2 Apprentice	$34.86	$11.68	$46.54

Roofer	1 Journeyman/ 3 Helpers $15.00	**$15.40**	**$0.00**	**$15.40**
Sheet Metal Worker (Excludes HVAC Duct and System Installation)	2 Journeyman/ 1 Apprentice	**$29.70**	**$13.85**	**$43.55**
Sheet Metal Worker (HVAC Duct Installation Only)	2 Journeyman/ 1 Apprentice	**$29.70**	**$13.85**	**$43.55**
Sheet Metal Worker (HVAC Unit Installation Only)	2 Journeyman/ 1 Apprentice	**$20.05**	**$2.24**	**$22.29**
Sprinkler Fitter (Fire Sprinklers)	1 Journeyman/ 1 Apprentice	**$36.15**	**$23.88**	**$60.03**
Tile Finisher	1 Journeyman/ 3 Helpers $15.00	**$15.00**	**$0.00**	**$15.00**
Tile Setter	1 Journeyman/ 3 Helpers $15.00	**$16.17**	**$0.00**	**$16.17**
Truck Driver- 1 Single Axle Truck		**$15.00**	**$0.00**	**$15.00**
Truck Driver- Dump Truck		**$15.00**	**$1.18**	**$16.18**
Truck Driver- Flatbed Truck		**$19.65**	**$8.57**	**$28.22**
Truck Driver- Semi-Trailer-Truck		**$15.00**	**$0.00**	**$15.00**
Truck Driver- Water Truck		**$15.00**	**$4.11**	**$19.11**
Waterproofer		**$15.00**	**$0.00**	**$15.00**
Welders-Receive rate prescribed for craft performing operation is which welding is incidental..				

This Verification is hereby incorporated into the terms of the contract by and between _**City of West University Place**___ and _**[Contractor]**_____entered into this the ____ of _____, .

1. __**[Contractor]**_____, in conjunction with the execution of the above referenced contract and in accordance with Chapter 2270 of the Texas Government Code, effective Sept. 1 2017, does hereby agree, confirm, and verify that it:

   A. Does not Boycott Israel; and
   B. Will not Boycott Israel during the term of the contract.

   "Boycott Israel" has the meaning given to it in Chapter 808 of Subtitle A, Title 8 of the Texas Government Code. As of the effective date of the statute, the term means "refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action make for ordinary business purposes."

2. Contractor hereby acknowledges and agrees that this verification is a material term of the contract and Owner is expressly relying on this verification in agreeing to enter into the contract with Contractor.

3. **TO THE MAXIMUM EXTENT PERMITTED BY LAW, CONTRACTOR AGREES TO INDEMNIFY, DEFEND AND HOLD HARMLESS OWNER FROM ALL CLAIMS, CAUSES OF ACTION, LEGAL PROCEEDINGS, DAMAGES, COSTS, FEES AND EXPENSES ARISING OUT OF OR RELATED TO AN ACTUAL OR ALLEGED MISREPRESENTATION BY CONTRACTOR PROVIDED HEREUNDER.**

[Signatures on Following Page]

Prohibition on Boycotting Israel Verification [Continued]

_____
Contractor

State of Texas
County of _____

Before me, a notary public, on this day personally appeared _____, known to me to be the person whose name is subscribed to the foregoing document and, being by me first duly sworn, declared that the statements therein contained in Paragraph 1A and B are true and correct.

(Personalized Seal)

_____
Notary Public's Signature

Receipt and incorporation into the above referenced contract hereby agreed to and acknowledged by:

_____
Owner

STANDARD FORM OF AGREEMENT

STATE OF TEXAS §
§
COUNTY OF HARRIS §

THIS AGREEMENT is dated as of the_____day of_____

in the year 2024 by and between City of West University Place, Texas (hereinafter called OWNER)

and _____(hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1. WORK.

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Wastewater Treatment Plant Improvements Phase 1

The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Wastewater Treatment Plant Improvements Phase 1

Article 2. ENGINEER.

The Project has been designed by:

KIMLEY-HORN
11700 KATY FREEWAY, SUITE 800
HOUSTON, TX 77079

Kimley-Horn and Associates, Inc. is hereinafter called ENGINEER and is to act as OWNER's representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

Article 3. CONTRACT TIME.

3.1. GRAND TOTAL CONTRACT TIME – All sections of work, as identified in the Bid Form, will be substantially completed within 700 Calendar Days from the date when the Contract Time commences to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraphs 15.06.B and 15.06.C of the General Conditions within 60 calendar days from the date when the Contract is substantially complete.

3.2. Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this

Agreement and that OWNER will suffer financial loss if the Work is not completed within the times specified in paragraph 3.1. above plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time.

Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER Five Hundred and 00/100 dollars ($500.00) for each day that expires after the time specified in paragraph 3.1. for Substantial Completion until the Work is substantially complete. After Substantial Completion if CONTRACTOR shall neglect, refuse or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER Five Hundred and 00/100 dollars ($500.00) for each day that expires after the time specified in paragraph 3.1 for completion and readiness for final payment.

Article 4. CONTRACT PRICE.

4.1. OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents in current funds as follows:

TOTAL BID OF $_____ AS IDENTIFIED IN THE BID FORM CONTAINED HEREIN.

Article 5. PAYMENT PROCEDURES.

CONTRACTOR shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.1. Progress Payments. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER, on or about the 25th day of each month during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in Article 2 of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Conditions.

5.1.1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with Article 15 of the General Conditions.

95 % of Work completed. If Work has been 50% completed as determined by ENGINEER, and if the character and progress of the Work have been satisfactory to OWNER and ENGINEER, OWNER on recommendation of ENGINEER, may determine that as long as the character and progress of the Work remain satisfactory to them, there will be no additional retainage on account of Work completed in which case the remaining progress payments prior to Substantial Completion will be in an amount equal to 100% of the Work completed.

95 % of materials and equipment not incorporated in the Work (but delivered, suitably stored and accompanied by documentation satisfactory to OWNER as provided in paragraph 15.01.B of the General Conditions).

5.1.2. Upon Substantial Completion, in an amount sufficient to increase total payments to CONTRACTOR to 95 % of the Contract Price, less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 15.01.C.5 of the General Conditions.

5.2. Final Payment. Upon final completion and acceptance of the Work in accordance with paragraphs 15.06.B and 15.06.C of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said paragraphs 15.06.B and 15.06.C.

Article 6. INTEREST.

All moneys not paid when due as provided in Article 15 of the General Conditions shall bear interest at the maximum rate allowed by law at the place of the Project.

Article 7. CONTRACTOR'S REPRESENTATIONS.

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representations:

7.1. CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

7.2. CONTRACTOR has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in paragraph 5.03.A and 5.03.B of the General Conditions, and accepts the determination set forth in paragraphs SC-5.04 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which CONTRACTOR is entitled to rely.

7.3. CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraphs 5.02 and 5.03 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.

7.4. CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said Underground Facilities are or will be required by CONTRACTOR in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 5.05 of the General Conditions.

7.5. CONTRACTOR has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

7.6. CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

Article 8. CONTRACT DOCUMENTS.

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work consist of the following:

8.1. This Agreement.

8.2. Performance, Payment and Maintenance Bonds as contained herein.

8.3. Certificate of Insurance.

8.4. General Conditions.

8.5. Supplementary Conditions.

8.6. Specifications bearing the title CONTRACT DOCUMENTS AND SPECIFICATIONS FOR THE **Wastewater Treatment Plant Improvements Phase 1**

8.7. Drawings bearing the following general title:

Wastewater Treatment Plant Improvements Phase 1

8.8. Addenda numbers _____ to_____, inclusive.

8.9. CONTRACTOR's Bid Form as contained herein.

8.10. Documentation submitted by CONTRACTOR prior to Notice of Award (pages_____ to_____, inclusive).

8.11. The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to paragraph 3.04 of the General Conditions.

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraph 11.01 of the General Conditions.

Article 9. MISCELLANEOUS.

9.1. Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.

9.2. No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law) and unless specifically stated to the contrary in any written consent to an assignment no

assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

9.3. OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in triplicate. One counterpart each has been delivered to OWNER, CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement will be effective on_____, 2024.

OWNER: City of West University Place, Texas	CONTRACTOR:
_____	_____
By_____ (Print Name)	By_____ (Print Name)
(CORPORATE SEAL)	(CORPORATE SEAL)
Attest_____	Attest_____
Address for giving notices:	Address for giving notices:
3800 University Boulevard	_____
West University Place, TX 77005	_____

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EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PERFORMANCE BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:
City of West University Place, Texas
3800 University Boulevard
West University Place, TX 77005

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description *(name and location)*: **Wastewater Treatment Plant Improvements, Houston, TX**

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount: **$**
Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	_____
Print Name	Print Name
President	_____
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature
_____	_____
Title	Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain

a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision

in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

None.

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:
City of West University Place, Texas
3800 University Boulevard
West University Place, TX 77005

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount: **$**
Description *(name and location)*: **Wastewater Treatment Plant Improvements; Houston, TX**

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount: **$**
Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

_____ *(seal)*
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ *(seal)*
Surety's Name and Corporate Seal

By: _____
Signature *(attach power of attorney)*

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond shall arise after the following:

   5.1 Claimants who do not have a direct contract with the Contractor,

      5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

      5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).

   5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall

promptly and at the Surety's expense take the following actions:

7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

7.2 Pay or arrange for payment of any undisputed amounts.

7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. **Definitions**

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default**: Failure of the Owner, which has not been remedied or

waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows: none.

City of West University Place, Texas PW24-18 Wastewater Treatment Plant Improvements Phase 1

MAINTENANCE BOND

STATE OF TEXAS

COUNTY OF HARRIS

KNOW ALL BY THESE PRESENTS: That _____whose address is _____hereinafter referred to as "Principal," and _____, a corporate surety/sureties organized under the laws of the State of _____ and fully licensed to transact business in the State of Texas, as Surety, hereinafter referred to as "Surety" (whether one or more), are held and firmly bound unto City of West University Place, Texas, a municipality, hereinafter referred to as "Owner," in the penal sum of _____Dollars $_____, in lawful money of the United States to be paid to Owner, its successors and assigns, for the payment of which sum well and truly to be made, we bind ourselves, our successors, heirs, executors, administrators and successors and assigns, jointly and severally; and firmly by these presents, the condition of this obligation is such that:

WHEREAS, Principal entered into a certain written Contract with the Owner, dated on or about the _____day of _____, 20 24 , to furnish all permits, licenses, bonds, insurance, products, materials, equipment, labor, supervision, and other accessories necessary for the construction of:

Wastewater Treatment Plant Improvements

in the City of West University Place, Texas as more particularly described and designated in the above-referenced contract, such contract being incorporated herein and made a part hereof as fully and to the same extent as if written herein word for word:

WHEREAS, in said Contract, the Principal binds itself to use first class materials and workmanship and of such kind and quality that for a period of two (2) years from the completion and final acceptance of the improvements by Owner the said improvements shall require no repairs, the necessity for which shall be occasioned by defects in workmanship or materials and during the period of two (2) years following the date of final payment of the Work by Owner, Principal binds itself to repair or reconstruct said improvements in whole or in part at any time within said period of time from the date of such notice as the Engineer shall determine to be necessary for the preservation of the public health, safety or welfare. If Principal does not repair or reconstruct the improvements within the time period designated, Owner shall be entitled to have said repairs made and charge Principal and/or Surety the cost of same under the terms of this Maintenance Bond.

NOW, THEREFORE, if Principal will maintain and keep in good repair the Work herein contracted to be done and performed for a period of two (2) years from the date of final payment and do and perform all necessary work and repair any defective condition (it being understood that the purpose of this section is to cover all defective conditions arising by reason of defective materials, work or labor performed by Principal) then this obligation shall be void; otherwise it shall remain in full force and effect and Owner shall have and recover from Principal and its Surety damages in the premises as provided in the Plans and Specifications and Contract.

PROVIDED, however, that Principal hereby holds harmless and indemnifies Owner from and against any claim or liability for personal injury or property damage caused by and occurring during the performance of said maintenance and repair operation.

PROVIDED, further, that if any legal action be filed on this Bond, exclusive venue shall lie in City of West University Place, Texas.

AND PROVIDED FURTHER, Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the Work performed thereunder, or the Plans, Specifications, Drawings, etc. accompanying same shall in any way affect its obligation on this Bond; and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the Work to be performed thereunder.

The undersigned and designated agent is hereby designated by Surety as the resident agent in Texas for service of process to whom all requisite notice may be delivered and on whom service of process may be had in matters arising out of this suretyship.

IN WITNESS WHEREOF, this instrument is executed in six copies, each one of which shall be deemed an original, on this the _____ day of _____, 20_24_.

ATTEST:	**PRINCIPAL**:
	_____.
	Company Name
By: _____	By:_____
Signature	Signature
_____	_____
Typed/Printed Name	Typed/Printed Name
_____	_____
Title	Title
_____	_____
Address	Address
_____	_____
City State Zip	City State Zip
_____	_____
Phone Fax	Phone Fax

ATTEST:

By: _____
Signature

_____
Printed Name

_____
Title

_____
Address

_____
Owner State Zip

_____
Phone Fax

SURETY:

By: _____
Signature

_____
Printed Name

_____
Title

_____
Address

_____
Owner State Zip

_____
Phone Fax

The Resident Agent of the Surety in Texas, for delivery of notice and service of the process is:

NAME: _____
STREET ADDRESS: _____
OWNER, STATE, ZIP: _____

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(SAMPLE FORM)

CERTIFICATE OF INSURANCE

TO: _____
Owner
_____
Address

Date _____
Project No. _____
Type of _____
Project _____

THIS IS TO CERTIFY THAT _____
(Name and address of insured)

is, at the date of this certificate, insured by this Company with respect to the business operations hereinafter described, for the types of insurance and in accordance with the provisions of the standard policies used by this Company, and further hereinafter described. Exceptions to standard policy noted on reverse side hereof.

TYPE OF INSURANCE

	Policy No.	Effective	Expires	Limits of Liability
Workman's Compensation				
				1 Person $
Public Liability				1 Accident $
Contingent				1 Person $
Liability				1 Accident $
Property Damage				
Builder's Risk				
Automobile				
Other				

The forgoing policies (do) (do not) cover all sub-contractors.

Locations Covered: _____

Descriptions of Operations Covered: _____

The above policies either in the body thereof or by appropriate endorsement provide that they may not be changed or cancelled by the insurer in less than fifteen days after the insured has received written notice of such change or cancellation.

Where applicable local laws or regulations require more than fifteen days actual notice of change or cancellation to the assured, the above policies contain such special requirements, either in the body thereof or by appropriate endorsement thereto attached.

_____

(Name of Insurer)

By _____

Title _____

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.

23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.

32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.

36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.

44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

46. *Technical Data*

    a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

48. *Unit Price Work*—Work to be paid for on the basis of unit prices.

49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*: The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents;
2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
2. The word "install," when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
3. The words "perform" or "provide," when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. *Contract Price or Contract Times*: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. *Evidence of Contractor's Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

A. *Standards Specifications, Codes, Laws and Regulations*

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. Abnormal weather conditions;

3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and

4. Acts of war or terrorism.

D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.

G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

B. *Underground Facilities*: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

C. *Reliance by Contractor on Technical Data*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;

3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or

4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;

2. is of such a nature as to require a change in the Drawings or Specifications;

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;

b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;

4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. *Engineer's Review*: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and

c. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.

F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

H. Contractor shall require:

1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and

2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.

I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

A. *Required Insurance*: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.

B. *General Provisions*: The policies of insurance required by this Paragraph 6.03 as supplemented must:

1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;

4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and

5. include all necessary endorsements to support the stated requirements.

C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;

2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;

3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.

2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that the proposed item:

1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) has a proven record of performance and availability of responsive service; and

4) is not objectionable to Owner.

b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:

    a. will certify that the proposed substitute item will:

        1) perform adequately the functions and achieve the results called for by the general design;

        2) be similar in substance to the item specified; and

        3) be suited to the same use as the item specified.

    b. will state:

        1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;

        2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

        3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

    c. will identify:

        1) all variations of the proposed substitute item from the item specified; and

        2) available engineering, sales, maintenance, repair, and replacement services.

    d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Contractor shall:

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. *Samples*

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. *Resubmittal Procedures for Shop Drawings and Samples*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.

2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. *Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03. 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and

2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.

C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer;

2. Recommendation by Engineer or payment by Owner of any progress or final payment;

3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. Use or occupancy of the Work or any part thereof by Owner;

5. Any review and approval of a Shop Drawing or Sample submittal;

6. The issuance of a notice of acceptability by Engineer;

7. The end of the correction period established in Paragraph 15.08;

8. Any inspection, test, or approval by others; or

9. Any correction of defective Work by Owner.

E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design

professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and

3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to

Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.

2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:

1. A mutually acceptable fixed fee; or

2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;

b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;

c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and

f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

    a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

    b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

    The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.

5. Other costs consisting of the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.

3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
3. by manufacturers of equipment furnished under the Contract Documents;
4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work;

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;

    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

    e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

   d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim, appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;
2. correct such defective Work;
3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their

reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if

repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

No specifications on this page for formatting purposes.

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the General Conditions and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

SC-1.01 DEFINITIONS:

The terms used in these Supplementary Conditions have the meanings assigned to them in the General Conditions or as amended below, which are applicable to both the singular and plural forms thereof.

SC-1.01.A.22 *Engineer*

Add the following language to the end of the definition:

"The word "Engineer" in these specifications shall be understood as referring to Kimley-Horn, 11700 Katy Freeway, Suite 800, Houston, Texas 77079, Engineer or the Owner, or such other representative as may be authorized by said Owner to act in any particular position."

SC-1.01.A.25 *Laws and Regulations*

Add the following language to the end of the definition:

"The term "Regulations" is defined to include laws, statutes, ordinances and lawful orders issued by governing authorities, as well as those rules, conventions and agreements within the construction industry which effectively control the performance of the work regardless of whether they are lawfully imposed by governing authority or not."

SC-1.01.A.30 *Owner*

Add the following language to the end of the definition:

"The words "Owner" or "City" in these documents shall be understood as referring to the City of West University Place, 3800 University Boulevard, West University Place, TX 77005."

SC-1.01.A.32 *Project*

Add the following language to the end of the definition:

"The project involves the construction of WASTEWATER TREATMENT PLANT IMPROVEMENTS. The project is located in the City of Houston, Texas."

SC-1.01.A.44 *Supplementary Conditions*

Add the following language to the end of the definition:

"Where in the Bonds and elsewhere in the contract, the terms "Special Provisions," and "Special Conditions" appear, they shall be read to mean "Supplementary Conditions."

SC-1.02 TERMINOLOGY:

Add the following new paragraphs after paragraph 1.02.G of the General Conditions:

H. *Indicated*: The term "indicated" is a cross-reference to graphic representations notes or schedules on the drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for the purpose of helping the

reader locate the cross-reference, and no limitation of location is intended except as specifically noted.

I. *Directed, Requested, etc*.: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted" mean "directed by the Engineer", "requested by the Engineer", and similar phrases. However, no such implied meaning will be interpreted to extend the Engineer's responsibility into the Contractor's area of construction supervision.

J. *Drawing Symbols*:

1. General: Except as otherwise indicated, graphic symbols used on the drawings are those symbols recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols are defined by "Architectural Graphic Standards", published by John Wiley & Sons, Inc., seventh edition.

2. Mechanical/Electrical Drawings: Graphic symbols used on mechanical and electrical drawings are generally aligned with symbols recommended by ASHRAE. Where appropriate, these symbols are supplemented by more specific symbols as recommended by other technical associations including ASME, ASPE, IEEE and similar organizations. Refer instances of uncertainty to the Engineer for clarification before proceeding.

K. *Abbreviations and Names*: Trade association names and titles of general standards are frequently abbreviated. Where acronyms or abbreviations are used in the specifications or other contract documents they are defined to mean the recognized name of the trade association, standards generating organization, governing authority or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations", published by Gale Research Co., available in most libraries.

SC-2.02 COPIES OF DOCUMENTS:

Delete the first sentence of paragraph 2.02.A of the General Conditions and replace with the following sentence:

"Owner shall furnish to Contractor up to five copies of the Contract Documents as are reasonably necessary for the execution of the Work."

SC-2.03.A BEFORE STARTING CONSTRUCTION:

Amend the first sentence of paragraph 2.03.A of the General Conditions to read as follows:

"Within five (5) days after the Effective Date of the Agreement (or as specifically required by the contract documents), Contractor shall submit to ENGINEER for timely review:"

SC-3.03.B RESOLVING DISCREPANCIES:

Add the following new paragraph immediately after Paragraph 3.03.B.1.b:

“2. Should a discrepancy arise in the Project Manual, the Construction Drawings shall take precedence

over the Specifications."

SC-4.01.A COMMENCEMENT OF CONTRACT TIMES; NOTICE TO PROCEED:

Delete paragraph 4.01.A of the General Conditions in its entirety and replace with the following paragraph:

"The Contract Time will commence to run on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement."

SC-4.02.A STARTING THE WORK:

Delete paragraph 4.02.A of the General Conditions in its entirety and replace with the following paragraph:

"Contractor shall start to perform the Work within ten (10) calendar days of the date when the Contract Time commences to run. No work shall be done at the site prior to the Effective Date of the Agreement."

SC-5.02 USE OF SITE AND OTHER AREAS:

Add the following paragraphs to GC-5.02:

"E. *Revegetation of Unpaved Areas*: The Contractor shall revegetate unpaved areas disturbed by construction prior to acceptance of the project. Revegetation shall consist of seed sowing, straw mulching, fertilizing and watering. Revegetation shall be acceptable when vegetation growth achieves one (1) inch in height, with 85% coverage, and no greater than 10 square feet bare. The cost for revegetation of unpaved areas shall be subsidiary to the various items in the bid form unless otherwise provided as a separate pay item."

"F. *Replacement of Fences*: All fences encountered and removed during construction of this project shall be restored to the original or a better than original condition upon completion of this project. Where wire fencing, either wire mesh or barbed wire is to be crossed, the Contractor shall set cross-braced posts on each side of the permanent easement before the fence is cut. Should additional fence cuts be necessary, the Contractor shall provide cross-braced posts at each point of the proposed cuts in addition to the cross-braced posts provided at the permanent easement limits, before the fence is cut. The cost for fence removal, temporary closures and replacement shall be subsidiary to the various items bid in the project proposal. Therefore, no separate payment shall be allowed for any service associated with this work."

"G. *Protection of Trees, Plants, and Soil*: All property along and adjacent to the Contractor's operations, including lawns, yards, shrubs, trees, etc., shall be preserved or restored after completion of the work, to a condition equal to or better than existed prior to start of the work. Trees that are to remain are identified on the plans and boring may be required to preserve the designated trees. Any trees or other landscaped features scarred or damaged by the Contractor's operations shall be restored or replaced at the Contractor's expense. Trimming or pruning to facilitate the work will be permitted only by experienced workmen in an approved manner and

only with the property owner's permission. Pruned limbs of 1" (one) diameter or larger, shall be thoroughly treated as soon as possible with a tree wound dressing.

The Contractor shall take all precautions required to prevent soil erosion during construction. If excessive erosion occurs, the Contractor shall take immediate measures to prevent further erosion and restore the disturbed surface with topsoil at completion of the work. No separate payment will be made for this work."

"H. *Underground Facilities*: All Underground Facilities along and adjacent to the Contractor's operations including septic tanks, drainfields, sprinkler systems, butane tanks, etc., shall be preserved or restored after completion of the work, to a condition equal to or better than existed prior to start of the work. No separate payment will be made for this work."

"I. *Impairment of Access*: Contractor shall make every reasonable effort to assure that adequate access is maintained to adjacent properties during the project. If conditions exist, occur or are encountered by the Contractor that will result in or cause any delay in the Contractor's performance of any part of the work beyond the time specified in the Agreement, Contractor shall take all reasonable steps necessary to assure that such prolonged performance does not materially or substantially impair access to adjoining businesses and properties, whether such impairment is inherently caused by the nature of the work, by the placement of temporary barriers by the Contractor or by any other cause. Contractor covenants and agrees to indemnify, hold harmless and defend Owner, its officers, agents, servants and employees from and against any and all claims, damages, losses and expenses, including but not limited to attorney's fees and court costs and other incidental litigation expenses, occasioned by or arising out of any claim or lawsuit, whether real or asserted, relating to such unnecessary or unreasonable impairment of access, whether based upon inverse condemnation, unnecessary or illegal taking of property or any other cause of action."

"J. *Confinement of Work:* The Contractor shall confine his construction activity and storage of material and equipment to the limits of the permanent and temporary construction easements, or the area designated by the owner."

"K. *WWTP site security:* The Contractor shall coordinate with Owner on maintaining WWTP site securing for the duration of the project. The Contractor shall be responsible for all temporary fence removal, temporary fence openings and any necessary locking equipment to maintain Owner's current level of security."

SC-5.04 DIFFERING SUBSURFACE OR PHYSICAL CONDITIONS:

Delete 5.04 in its entirety.

SC-6.01 PERFORMANCE, PAYMENT, AND OTHER BONDS:

SC-6.01.A Delete Paragraph 6.01.A. in its entirety and insert the following in its place:

"A Contractor shall furnish performance and payment Bonds in accordance with Chapter 2253, Texas Government Code, each in an amount at least equal to the Contract Price as security for the faithful

performance and payment of all of the Contractor's obligations under the Contract Documents. Contractor shall also furnish a maintenance bond in the amount of one hundred (100%) of the Contract Amount guaranteeing the Work and workmanship against defects. The performance, payment, and maintenance bonds will remain in effect at least two years after the date of when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents."

SC-6.01.B Amend the last sentence of Paragraph 6.01.B to read as follows:

"All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act and must be issued by sureties licensed by the State of Texas to provide surety bonds."

SC-6.02 INSURANCE-GENERAL PROVISIONS:

6.02.G. Delete Paragraph 6.02.G of the General Conditions in its entirety and replace with the following:

"The Contractor shall file with Owner a Certificate of Insurance naming the Owner as an additional insured with regard to the contract project and evidencing insurance coverage of limits not less than the limits indicated in SC-6.03."

6.02.N. Add the following to the end of Paragraph 6.02.N:

"The Contractual Liability required by paragraph 6.02.N. of the General Conditions shall provide coverage for not less than the following amounts:

Bodily Injury:	
$500,000	Each Occurrence
Property Damage:	
$200,000	Each Occurrence
$500,000	Annual Aggregate"

SC-6.03.A REQUIRED INSURANCE:

6.03.A. Add the following to the end of Paragraph 6.03 .A:

"The limits of liability for the insurance required by paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations.

6.03.A. Workers' Compensation, etc. under paragraph 6.03.A. of the General Conditions:

(1)	State:	Statutory
(2)	Applicable Federal (e.g. Longshoreman's):	Statutory
(3)	Employer's Liability:	$500,000

6.03.A. Comprehensive General Liability (under paragraph 6.03.A of the General Conditions):

(1) Bodily Injury (including completed operations and products liability):

$500,000	Each Occurrence
$1,000,000	Annual Aggregate

Property Damage:

$200,000	Each Occurrence
$500,000	Annual Aggregate

(2) Property Damage liability insurance will provide Explosion, Collapse and Under-ground coverage where applicable.

(3) Personal Injury, with employment exclusion deleted

$500,000	Annual Aggregate

6.03.A. Comprehensive Automobile Liability:

Bodily Injury:

$200,000	Each Person
$500,000	Each Occurrence

Property Damage:

$200,000	Each Occurrence

The entities listed below are additional insureds as their interest may appear including their respective officers, directors, agents and employees.

OWNER: City of West University Place, TX
ENGINEER: Kimley-Horn and Associates Inc. "

SC-6.04.A BUILDER'S RISK:

Delete Paragraph 6.04.A of the General Conditions in its entirety and insert the following in its place:

"6.04.A. Contractor shall purchase and maintain until final payment property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall include the interests of Owner, Contractor, Subcontractors, Engineer and Engineer's consultants in the Work (all of whom shall be listed as insured or additional insured parties), shall insure against the perils of fire and extended coverage, shall include "all-risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in these Supplementary Conditions, and shall include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property

(including but not limited to fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all-risk" insurance or otherwise provided in these Supplementary Conditions, Contractor shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment. The policies of insurance required to be purchased and maintained by Contractor in accordance with this paragraph 6.04.A shall comply with the requirements of GC-6.02.N"

SC-6.04.E INSURANCE OF OTHER PROPERTY:

Delete Paragraph 6.04.E of the General Conditions in its entirety.

SC-6.07 WORKERS' COMPENSATION INSURANCE COVERAGE:

Add the following paragraphs to Article 6 of the General Conditions:

"6.07 Workers' Compensation Insurance Coverage.

"In addition to other insurance requirements stipulated herein, the Contractor shall comply with all requirements of 28 TAC 110.110 and other requirements outlined in this section. Definitions contained in this section are for this section only."
“6.07.A. Definitions:

Certificate of coverage ("certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or Owner's employees providing services on a project, for the duration of the project."

Duration of the project - includes the time from the beginning of the work on the project until the Contractor's/person's work on the project has been completed and accepted by the Owner.

"Persons providing services on the project ("subcontractor") - includes all persons or entities performing all or part of the services the Contractor has undertaken to perform on the project regardless of whether that person contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. Services include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets."

"6.07.A.1 The Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the Contractor providing services on the project, for the duration of the project."

"6.07.A.2 The Contractor must provide a certificate of coverage to the Owner prior to being awarded the

contract."

"6.07.A.3 If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the Owner showing that coverage has been extended."

"6.07.A.4 The Contractor shall obtain from each person providing services on a project, and provide to the Owner:

(1) a certificate of coverage, prior to that person beginning work on the project, so the Owner will have on file certificates of coverage showing coverage for all persons providing services on the project; and

(2) no later than seven days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project."

"6.07.A.5 The Contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter."

"6.07.A.6 The Contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project."

"6.07.A.7 The Contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage."

"6.07.A.8 The Contractor shall contractually require each person with whom it contracts to provide services on a project, to:

(1) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the project, for the duration of the project;

(2) provide to the Contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;

(3) provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(4) obtain from each other person with whom it contracts, and provide to the Contractor:

(a) a certificate of coverage, prior to the other person beginning work on

the project; and

(b) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(6) notify the Owner in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(7) contractually require each person with whom it contracts, to perform as required by paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services."

"6.07.A.9 By signing this contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the Owner that all employees of the Contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the CONTRACTOR to administrative penalties, criminal penalties, civil penalties, or other civil actions."

"6.07.A.10 The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the Owner to declare the contract void if the Contractor does not remedy the breach within ten days after receipt of the notice of breach from the Owner."

"6.07.A.11 The text for the notice prescribed in 6.07.A.7 shall read as follows:

REQUIRED WORKERS' COMPENSATION COVERAGE

The law requires that each person working on this site or providing services related to this construction project must be covered by workers' compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee."

"Call the Texas Workers' Compensation Commission at 512-440-3789 to receive information on the legal requirement for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

SC-7.06.D REIMBURSEMENT OF ENGINEER'S COST:

Add the following language at the end of the last sentence of Paragraph 7.06.D:

"Contractor shall not be required to reimburse Owner for Engineer's charges if the substitution is beyond the control of the Contractor."

SC-7.07.A CONCERNING SUBCONTRACTORS AND SUPPLIERS:

Add the following sentence to paragraph 7.07.A of the General Conditions:

"Contractor shall not award Work under the Contract to a Subcontractor(s) that is (are) in excess of 50% of the total contract price without written approval of the Owner."

SC-7.09 PERMITS:

Add the following paragraphs to GC 7.09.A

"Under the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et.seq.; the Act), except as provided by NPDES General Permits for Storm Water Discharges from Construction Activities Part I, as published in Federal Register/Vol. 63, No. 128/Monday, July 6, 1998 for disturbances 5 acres or greater and Part II, as published in Federal Register/Vol. 64, No. 235/Wednesday, December 8, 1999 for disturbances less than 5 acres but greater than or equal to 1 acre. Federal law prohibits discharges of pollutants in storm water from construction activities without a National Pollutant Discharge Elimination System Permit (NPDES). Operator(s) of construction sites where 1 or more acres are disturbed, smaller sites that are part of a larger common plan of development or sale where there is a cumulative disturbance of at least 1 acre, or any site designated by the Director, must submit an NOI to obtain coverage under an NPDES Storm Water Construction General Permit.

For the purpose of this project the contractor shall be the "Operator". If required to submit a Notice of Intent (NOI) for storm water discharges associated with construction activities under the NPDES General Permit with EPA, the contractor shall submit the NOI at least two (2) days prior to commencement of construction. In addition to submitting the NOI, the Contractor shall prepare and retain on-site a Storm Water Pollution Prevention Plan in accordance the EPA requirements.

"B. Notwithstanding the reference herein stated, nothing shall obligate the Owner or Engineer to advise Contractor of the applicable Laws and Regulations, or waives or modifies Contractor's obligations under this Section 7.09."

SC-7.10 TAXES:

Add the following paragraphs to paragraph 7.10.A of the General Conditions:

"The Contractor's attention is directed to Amendment No. 7 in Section 6a, Article 20.01, Chapter 20, Title 122A, Taxation-General of the Revised Civil Statutes of Texas and the recent amendments contained in H.B. 11 as passed by the Legislature of the State of Texas and enacted August 13, 1991."

"These statutes provide that all items used by a Contractor, and incorporated into the project, can be

purchased free of State and City sales tax when the project is being performed by an exempt agency. Excluded are equipment rentals and other items which are consumed by the Contractor but are not incorporated into the project."

"This contract is issued by an organization which qualifies for exemption pursuant to the provisions of Article 20.04 (F) of the Texas Limited Sales, Excise and Use Tax Act."

"The Contractor performing this contract may purchase all materials, supplies, equipment used in the performance of this contract by issuing to his supplier an exemption or resale certificate."

"It shall be the sole responsibility of the Contractor under the terms of this agreement to determine the applicability of the revisions to the tax code and pay all applicable taxes associated with this project without additional or separate pay for the same from the Owner."

SC-7.12 RECORD DOCUMENTS:

Add the following sentence to paragraph 7.12.A of the General Conditions:

"Contractor will submit, upon completion of the project, record drawings of full size."

SC-7.13 SAFETY AND PROTECTION:

Revise paragraph 7.13.C.3 of the General Conditions to read as follows:

"other property at the site or adjacent thereto, including trees, shrubs, lawns, lawn irrigation systems,..."

Add the following paragraphs to Article 7.13.F of the General Conditions:

"The Contractor shall comply with the provisions of the Occupational Safety and Health Act of 1970, and the standards and regulations issued thereunder and warrant that all work, materials, and products furnished under this contract will conform to and comply with said standards and regulations which are in existence on the date of this contract. The Contractor further agrees to indemnify and hold harmless the Owner and the Engineer for all damages suffered by the Owner and the Engineer as a result of the Contractor's failure to comply with the Act and the Standards issued thereunder and for the failure of any material and/or equipment furnished under this contract to so comply."

"The Contractor shall also comply with all pertinent provisions of the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., if not in conflict with those of the Occupational Safety and Health Act of 1970 and shall maintain an accurate record of all cases of death, occupational disease, and injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment or work under the contract."

"The Contractor alone shall be responsible for the safety, efficiency, and adequacy of his equipment and employees, and for any damage which may result from their failure or their improper construction, maintenance or operation."

"Per Texas House Bill 1569 effective as of September 1, 1989, it shall be the responsibility of the contractor to provide and maintain a viable trench safety system at all times during construction activities. The contractor is directed to become knowledgeable and familiar with the standards as set forth by the Occupational Safety and Health Administration (OSHA) for trench safety that will be in effect during the period of construction of the project and the contract is responsible for conforming to such regulations as prescribed by OSHA standards. A bid item for trench excavation safety protection and shoring is included in the proposal."

SC-7.20 WAGE RATES:

Add a new paragraph to ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES of the General Conditions as follows:

"7.20 *Wage Rates*

A. The prevailing wage rates applicable for this project are attached and made a part of these Contract Documents. Wages not less than these rates must be paid on this project."

SC-10.06 DECISIONS ON REQUIREMENTS OF CONTRACT DOCUMENTS AND ACCEPTABILITY OF WORK:

Add the following sentence to Paragraph 10.06.A after the first sentence:

"All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 7 days of the event giving rise to the question."

SC-14.02 TESTS, INSPECTIONS, AND APPROVALS:

Amend paragraph G.C. 14.02.B of the General Conditions to read as follows:

"Contractor shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests. The independent inspector, testing laboratory, or other qualified individual or entity shall be approved by Owner a minimum of 10 working days prior to any work being performed.

SC-15.01.A BASIS FOR PROGRESS PAYMENTS:

Amend the first sentence of Paragraph 15.01.A to read as follows:

"A. The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments, subject to acceptance by Engineer, and will be incorporated into a form of Application for Payment acceptable to Engineer."

SC-15.01.B APPLICATIONS FOR PAYMENTS:

Add a new sentence to the end of paragraph 15.01.B.2 of the General Conditions to read as follows:

"Prior to submitting Application for Payment to Engineer for review, the Contractor shall obtain the Project Inspector's signature verifying that record documents have been updated to reflect variations from the "As Bid" drawings up to the date for which the Contractor seeks payment."

SC-15.01.D.1 PAYMENT BECOMES DUE:

Revise paragraph 15.01.D.1 of the General Conditions to read as follows:

"Thirty (30) days after presentation of the Application for Payment with Engineer's recommendation, the amount recommended will (subject to the provisions of paragraph 14.02.D) become due and when due will be paid by Owner to Contractor."

SC-15.08 TWO YEAR CORRECTION PERIOD:

Revise the title of paragraph 15.08 of the General Conditions to read "TWO YEAR CORRECTION PERIOD" and revise the content of paragraphs 15.08A, 15.08.B, 15.08.C, 15.08.D, 15.08.E, and 15.08.F to reflect "two (2) years" where "one (1) year" is indicated.

SC-18 MISCELLANEOUS:

Add the following paragraphs to Article 18 of the General Conditions:

"18.11 *Explosives*

A. The use of explosives will not be allowed under this contract for the construction of the proposed facilities without approval of the Engineer and Owner."

"18.12 *Use of Domestic Construction Materials*

The Contractor is encouraged to abide by the Buy American Provision of Public Law 95-217 (Section 215) of Public Law 92-500 as amended) generally requiring that preference be given to the use of domestic construction materials in the performance of this contract."

"18.13 *Field Office*

The Contractor will not be required to furnish a field office on this contract."

SC-19 PAY ITEMS:

Add a new Article to the General Conditions entitled ARTICLE 19 - PAY ITEMS with the following paragraphs to be included:

Any and all Work specifically called for in the Contract Documents or which is required for the proper construction of items called for in the Contract Documents is to be performed by Contractor unless specifically indicated otherwise.

The cost of all work for which there is no separate pay item in the proposal shall be included in the price for a related pay item such that work called for or required by the Contract Documents will be

constructed for the Contract Price.

Specification Section 01 22 00 includes pay item descriptions and are intended to clarify the nature of the work required for this project, the provisions of the standard technical specifications shall apply, except as otherwise noted in Specification Section 01 22 00:

Each pay item shall include all labor, materials, equipment and incidentals necessary to construct that item.

SECTION 01 10 10

SUMMARY OF WORK

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. Under this Contract, CONTRACTOR shall furnish all materials, appliances, tools, equipment, transportation, services, and all labor and superintendence necessary for the construction of the work as described in these Technical Specifications and as shown on the Drawings. The completed installation shall not lack any part which can be reasonably implied as necessary to its proper functioning or any subsidiary item which is customarily furnished, and CONTRACTOR shall deliver the installation to OWNER in operating condition.

B. The Work includes furnishing all labor, materials, and equipment, and performing all work necessary for improvements to the existing 2.0 million gallon per day Wastewater Treatment Plant (WWTP) described in the drawings and project manual.

C. Proposed improvements include electrical power service improvements, demolition of existing ground tank, motor control center and control improvements, disinfection improvements (Alternate 1), replacement of screw pumps with submersible pumps, a new control building, installation of security cameras, structural improvements, and other associated improvements for successful project completion, as described in the Specifications and shown on the Drawings.

D. CONTRACTOR is responsible for close coordination with the WWTP Operations staff who will maintain and operate the WWTP throughout construction.

1.02 LOCATION

A. The WWTP is owned by the City of West University Place, Texas. The project is located in the City of Houston, Texas, at 2801 N Braeswood Blvd, Houston, TX 77025.

1.03 EXAMINATION OF THE SITE

A. CONTRACTOR is required to visit the Site, compare drawings and specifications with any work in place, and inform themselves of all conditions, including other work, if any, are being performed. Failure to visit the site shall not relieve the CONTRACTOR from the necessity of furnishing materials or performing work required to complete work in accordance with the Contract Documents without additional cost to the OWNER. The CONTRACTOR shall coordinate with the ENGINEER for access to the site.

B. Although reasonable care was used in reviewing the channel conditions and providing recommendations within the report, conditions may be encountered which may vary from those as reported therein. Submitting a Bid on the forms provided with the Contract Documents shall acknowledge that the sites have been inspected by the Respondent, or that the right to do so has been waved.

1.04 CONTRACTS

A. The General CONTRACTOR shall perform the Work under a single contract as designated in the OWNER-CONTRACTOR Agreement.

1.05 CONTRACTOR'S USE OF PREMISES

A. Coordinate use of premises under direction of the OWNER, or the OWNER's authorized representative.
B. Assume full responsibility for protection and safekeeping of products under this Contract, stored on site.

1.06 PARTIAL OWNER OCCUPANCY

A. The OWNER reserves the right to take possession and use any completed or partially completed portion of the Project regardless of the time of completion of the Project, providing it does not interfere with the CONTRACTOR's work. Such possession or use of the Project shall not be construed as final acceptance of the project or any portion thereof.
B. OWNER will continue to operate the WWTP throughout the construction period. CONTRACTOR is responsible for close coordination with operations staff especially related to required shut downs of power, equipment, and processes.

1.07 SAFETY

A. CONTRACTOR is responsible for the safety of his personnel. These specifications do not extend to or include designs or systems pertaining to the safety of the CONTRACTOR or its employees, agents, or representatives in the performance of this work. The seal of the licensed Engineer hereon does not extend to any such safety systems that may now or hereafter be incorporated in the specifications. The CONTRACTOR shall prepare or obtain the appropriate safety systems.

END OF SECTION

SECTION 01 20 00
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. The prices included in the Bid Form will be full compensation for all labor, materials, tools, equipment and incidentals, permit fees, bonds, taxes, mobilization/demobilization, insurance, overhead and profit, temporary access roads and facilities, and other miscellaneous costs necessary to complete the construction as shown on the Drawings and/or as specified in the Contract Documents to be performed under this Contract. Actual quantities of each item bid on a unit price basis will be determined upon completion of the construction in the manner set up for each item in this section of the specifications. Payment for all items listed in the Bid Form will constitute full compensation for all work shown and/or specified and required to accomplish the intent of this Contract.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

C. Not all work required, significant or incidental, is identified in this section or the Schedule of Prices. Where work is shown on the Drawings or specified in the Specifications but not specifically described in this section or is incidental to or affiliated with the work as identified, the work shall be deemed to be included in the value of the work described in the payment items with which the work is most closely associated. Examples of incidental work include:

1. Stripping, Clearing and Grubbing
2. Compaction Testing
3. Construction Staking and Survey
4. Cleaning

D. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. In some cases, a unit price item has been added to the bid schedule to establish a cost basis in the event work associated with that item is required. No guarantee is expressed or implied that the quantities shown in the bid schedule shall be required to fulfill the Contract.

E. Payment for any stored material or equipment shall not imply that the material or equipment meets the Contract Specifications or that it will be found acceptable when incorporated into the Work.

F. Retainage and other payment conditions apply to all payments.

PART 2 - PRODUCTS [NOT USED]

PART 3 - EXECUTION

3.1 MOBILIZATION

A. The work under this item shall include the establishment of offices and other facilities on the project site and the movement of personnel, construction equipment and supplies to the project site or to the vicinity of the project site in order to enable the Contractor to begin work on the contract. The cost of all bonds and insurance for the project will also be considered part of this specification.

B. Mobilization will be measured as a lump sum item as the work progresses. The adjusted contract amount for construction items as used below is defined as the total contract amount less the lump sum bid for Mobilization. Partial payments for mobilization shall be paid for at the Total Unit Price as shown in the bid proposal with the regular monthly estimates as follows:

1. When 1% and less than 5% of the adjusted contract amount for construction items is completed, 50% of the mobilization lump sum bid will be paid.
2. When 5% and less than 10% of the adjusted contract amount for construction items is completed, 75% of the mobilization lump sum bid will be paid. Previous payments under this section will be deducted from this amount.
3. When 10% or more of the adjusted contract amount for construction items is completed, 95% of the mobilization lump sum bid will be paid. Previous payments under this section will be deducted from this amount.
4. Payment for the remainder of the lump sum bid for “Mobilization” will be made on the final estimate.

C. This pay item shall encompass mobilization costs on a lump sum basis for the entire project.

3.2 TEMPORARY EROSION, SEDIMENTATION, AND WATER POLLUTION PREVENTION CONTROL

A. This item shall consist of all the work, labor, materials, and equipment associated with installing erosion control measures shall be in accordance with City of Houston Storm Water Management Handbook for Construction Activities. The Contractor shall be responsible for determination of adequate and appropriate control measure items, quantities, and locations, and shall include this information in the submitted Storm Water Pollution Prevention Plan.

B. This item is generally shown in the drawings in Volume I: Site Civil Plans sheets C3.0 and C3.1.

C. This item is generally described in technical specifications 01 31 46 and 01 57 13.

D. Measurement for payment shall be on a lump sum basis.

3.3 SITE CIVIL WORK

A. This item shall consist of all work, labor, tools, materials, and incidentals necessary to complete in place, the site clearing, paving, drainage, grading, plumbing, fencing, removal of spoils and all other site related work not accounted for by other pay items as shown in the Contract Documents and as listed in the following paragraphs.

B. Paving, drainage, and grading shall include, but is not limited to, subgrade preparation, drainage inlets, curb & gutters, culverts, installation of asphalt, slope stabilization, revegetation, and concrete flat work.

C. This item shall include all work, labor, tools, materials, equipment, and incidentals necessary to furnish and install the yard piping, connections to existing structures, excavation, embedment, and backfill as shown in the plans and in the specifications. Yard piping shall include, but is not limited to all meters, hydrants, valves, hose bibs, manholes, cleanouts, thrust blocking, pipe restraints and supports, fittings, and piping.

D. This item shall include all work, labor, tools, materials, equipment, and incidentals necessary to furnish and install the storm drain system, stormwater underground detention system, drainage gates, and detention pond as shown in the plans and in the specifications.

E. This item shall include all work, labor, tools, materials, equipment, and incidentals necessary to furnish and install the retaining wall, site fence, gate, and as shown in the plans and in the specifications.

F. This item shall include all work, labor, tools, materials, equipment, and incidentals necessary to coordinate utility connections and relocations as shown in the plans and in the specifications.

G. This item includes coordination with City of Houston inspectors.

H. This item is generally shown in the drawings in Volume I: Site Civil Plans sheets C0.0 to C9.2.

I. This item is generally described in technical specifications in divisions 03, 13, 31, 32, 33, and 34.

J. Measurement for payment shall be on a lump sum basis.

3.4 DEMOLITION

A. This item shall consist of all work, labor, tools, materials, equipment, and incidentals necessary for the demolition and removal of structures as shown in the plans and in the specifications. Demolition pay items includes removal and proper disposal of demolished materials.

B. Demolition shall include Site clearing, and is not limited to, the removal of existing fencing, trees, shrubs and any miscellaneous items that are conflict with the proposed improvements. Appendix includes a subsurface exploration to identify buried rubble from previous structures on the site.

C. Demolition shall include removal of the existing ground storage tank (approximate dimensions 36-foot diameter, 12-feet tall) including walls and slab. This item includes testing the tank for hazardous materials and appropriate disposal. The existing tank roof was previously removed and the tank has been out of service for over a decade.

D. Demolition shall include demolition and recycling of electrical service, generator pad and railings.

E. Demolition shall include demolition and recycling of existing chlorination system. The chlorination shed structure will remain.

F. Demolition shall include demolition and recycling of existing screw pumps and related structures.

G. This item is generally shown in the drawings in Volume I: Site Civil Plans sheet C2.0 and Volume III: WWTP Plans sheets C-600, M-300 to M304, and S-007.

H. This item is generally described in technical specifications in Division 2.

I. Measurement for payment shall be on a lump sum basis.

3.5 INFLUENT LIFT STATION

A. This item shall consist of all work, labor, tools, materials, equipment, and incidentals necessary to furnish and install the proposed lift station including but not limited to: the wet well, excavation, backfill, piping, appurtenances, pipe supports, submersible pumps, access hatch, startup, testing, and operator training in accordance with the Contract Documents for the project.

B. This item is generally shown in the drawings in Volume III: WWTP Plans sheets M-100 through M-102.

C. This item is generally described in technical specifications 33 32 00.

D. Measurement for payment shall be on a lump sum basis. Upon approval of shop drawing Contractor may submit up to 10% of this pay item in the subsequent Pay App.

3.6 CONSOLIDATED OPERATIONS AND MAINTENANCE MANUAL

A. This item shall consist of all work, labor, materials, equipment, and incidentals necessary to provide a custom consolidated operations and maintenance manuals incorporating the key information for all installed equipment regardless of manufacturer and providing an overall operation guidebook with various scenarios for treatment. Custom-designed operation and maintenance manuals will be delivered in binders and in digital format.

B. This item is generally described in technical specification 01 78 23.

C. Measurement for payment shall be on a lump sum basis.

3.7 WWTP STRUCTURAL IMPROVEMENTS

A. This item shall consist of all work, labor, tools, materials, equipment, and incidentals necessary to perform structural repairs on buildings and treatment units. There are signs of wear on several areas of the plant. A structural analysis was performed to check for safety or structural concerns that need to be addressed.

B. This item is generally shown in the drawings in Volume III: WWTP Plans sheets S-001 through S-006.

C. This item is generally described in technical specifications division 03.

D. Measurement for payment shall be on a lump sum basis.

3.8 CONTROL BUILDING

A. This item shall consist of all work, labor, tools, materials, equipment, and incidentals necessary to furnish and install the proposed Control Building, structures, platforms, and elevator in accordance with the Contract Documents.

B. This item includes coordination with City of Houston inspectors.

C. This item is generally shown in the drawings in Volume II: Building Permit Plans (all sheets).

D. This item is generally described in technical specifications in divisions 04, 05, 06, 07, 08, 09, 10, 11, 12, and 14.

E. This item includes the coating of existing structures on shown in Volume II: Building Permit Plans sheet A-973 and described in technical specification 09 96 00.

F. Measurement for payment shall be on a lump sum basis.

3.9 SECURITY CAMERAS

A. This item shall consist of all work, labor, tools, materials, equipment, and incidentals necessary to closed circuit television cameras, required poles and mounting hardware, communications infrastructure, and integration with the Owner's existing security camera system.

B. This item is generally shown in the drawings in Volume III: WWTP Plans sheets E-1000 through E-1003.

C. This item is generally described in technical specifications in division 28.

D. Measurement for payment shall be on a lump sum basis.

3.10 SYSTEM INTEGRATOR ALLOWANCE

A. The City of West University Place, Texas has selected a Video Surveillance Systems, Wireless Access, Security Alarms, and Fire Control system integrator (Mobile Communications America, Inc., contact Jeff Paris, (832) 786-5822, jeffparis@callmc.com or Chris Lloyd, 832-786-5807, chrislloyd@callmc.com). This allowance will include the current quote from MCA for integrating the new control building systems into the current city networks. Contractor will provide all required coordination, connections, power, and finishes for complete functional systems as described in the Contract Documents.

B. This item is generally shown in the drawings in Volume III: WWTP Plans sheets TN001 to TN501.

C. This item is generally described in technical specifications divisions 27 and 28.

D. Measurement for payment shall be on a lump sum basis.

3.11 INTEGRATION OF EXISITNG CHLORINE AND DECHLOR SYSTEMS

A. This item shall consist of all work, labor, tools, materials, equipment, and incidentals necessary to integrate the existing chlorine gas system and existing dechlorination system to the proposed electrical system.

B. This item is generally shown in the drawings in Volume III: WWTP Plans.

C. Measurement for payment shall be on a lump sum basis.

3.12 SITE ELECTRICAL, INSTRUMENTATION, AND CONTROL

A. This pay item shall consist of all work, labor, materials, equipment, and incidentals necessary to complete in-place site electrical as described in the contract documents. Contractor shall coordinate with electrical provider.

B. Electrical, Instrumentation, and Control items shall include, but are not limited to, the following: Motor Control Center (MCC), site lighting, conduit duct banks, wire and cable, fixtures and receptacles, panelboards, commissioning, SCADA equipment, relay settings, testing, and startup services.

C. This item shall consist of the work, labor and materials necessary to complete in place the programing, testing and verification of the proposed SCADA system. This work shall include but

is not limited to: coordination with manufacturer, programming associated with PLCs, I/O modules, network components, power supplies and batteries.

D. This item is generally shown in the drawings in Volume III: WWTP Plans sheets E-001 to E-916.

E. This item is generally described in technical specifications in Division 26.

F. Measurement for payment shall be on a lump sum basis. Upon approval of shop drawing Contractor may submit up to 10% of this pay item in the subsequent Pay App.

3.13 ELECTRICAL POWER SERVICE IMPROVEMENTS

A. This pay item shall consist of all work, labor materials, equipment, and incidentals necessary to complete in-place site electrical as described in the contract documents. Contractor shall coordinate with electrical provider.

B. Electrical power items shall include, but are not limited to, the following: conduit duct banks, wire and cable, fixtures and receptacles, grounding for each building, temporary power setup, lightning protection, pad mounted transformer, moving the and re-installing the existing generator, panelboards, commissioning, relay settings and testing, and startup services.

C. This pay item shall consist of all work, labor, materials, equipment, and incidentals necessary to relocate the existing site backup generator and related switch gear including required electrical connections. This includes maintenance of power throughout the construction phases to keep the WWTP operational and coordination of any required power outages with the WWTP operations staff.

D. This item is generally shown in the drawings in Volume III: WWTP Plans sheet E-007 and E-012.

E. This item is generally described in technical specifications in Division 26.

F. Measurement for payment shall be on a lump sum basis. Upon approval of shop drawing Contractor may submit up to 10% of this pay item in the subsequent Pay App.

3.14 CENTERPOINT ENERGY ALLOWANCE

A. This pay item shall consist of an allowance to be paid to CenterPoint for site electrical service, and Contractor shall be reimbursed after submitting invoices from CenterPoint for work necessary to complete in-place site electrical as described in the contract documents. Contractor shall coordinate with electrical provider.

B. Measurement for payment shall be on a lump sum basis.

3.15 TRENCH SAFETY

A. This item consists of the required trench safety measures for underground utility lines. This item consists of the required trench safety measures for utility trench excavation. It shall be the responsibility of the Contractor to provide and maintain a viable trench safety system at all times during construction activities. The Contractor is directed to become knowledgeable and familiar with the standards as set forth by the Occupational Safety and Health Administration (OSHA) for trench safety that will be in effect during the period of construction of the project and the Contractor is responsible for conforming to such regulations as prescribed by OSHA standards. A bid item for trench excavation safety protection and/or shoring is included in the proposal.

B. Per Texas House Bill 1569 effective as of September 1, 1989, it shall be the responsibility of the Contractor to provide and maintain a viable trench safety system at all times during construction activities. The Contractor is directed to become knowledgeable and familiar with the standards as set forth by the Occupational Safety and Health Administration (OSHA) for trench safety that will be in effect during the period of construction of the project and the Contractor is responsible for conforming to such regulations as prescribed by OSHA standards. A bid item for trench excavation safety protection and/or shoring is included in the proposal.

C. Measurement for payment shall be on a lump sum basis.

3.16 ADDITIVE ALTERNATE A-1: DISINFECTION SYSTEM

A. This item shall consist of all work, labor, tools, materials, equipment, and incidentals necessary to replace the existing chlorination and dechlorination system and building, and convert the existing chlorine gas disinfection system to liquid bleach. Item includes new structure, storage tanks, piping, and chemical feed pumps, and decommissioning of the existing system in accordance with the Contract Documents for the project.

B. This item is generally shown in the drawings in Volume III: WWTP Plans sheets M-400A to M-401A.

C. This item is generally described in technical specification 46 30 00.

3.17 ADDITIVE ALTERNATE A-2: REMOVEABLE FLOOD PROTECTION WALLS

A. This item shall consist of all work, labor, tools, materials, equipment, and incidentals necessary to procure and deliver removable flood protection barriers, Mayim Modular Flood Barrier MB-2 by Garrison Flood Control, or approved equal.

B. Estimated Quantity: 60 Linear Feet

C. Measurement for payment shall be on a per linear foot installed basis.

3.18 ADDITIVE ALTERNATE A-3: VERTICAL CRACK INJECTION FOR EXISTING CONCRETE

A. Estimated quantity: 2,000 Linear Feet

B. Measurement for payment shall be on a per linear foot installed basis.

3.19 ADDITIVE ALTERNATE A-4: CONCRETE JOINT REPAIR FOR EXISTING CONCRETE

A. Estimated quantity: 1,500 Linear Feet

B. Measurement for payment shall be on a per linear foot installed basis.

3.20 ADDITIVE ALTERNATE A-5: CONCRETE MORTAR REPAIR FOR EXISTING CONCRETE

A. Estimated quantity: 75 Cubic Feet

B. Measurement for payment shall be on a per cubic foot installed basis.

END OF SECTION

SECTION 01 29 73
Schedule of Values

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the requirements for requesting approval of partial payment on a Schedule of Values including a Material on Hand basis for specific pay items.
B. Refer to Section 01 20 00 - Measurement and Payment.

1.02 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures.
B. Submit the Schedule of Values or Material on Hand submittals to the Engineer for review and approval.
C. After review by the Engineer, revise and resubmit the submittals, if required. The initial Application for Payment on a Schedule of Values or a Material on Hand basis will not be processed until the submittals are approved.
D. During review, the Engineer may request additional documentation to support the data on the submittals.

1.03 REQUIREMENTS AND CONDITIONS

A. Schedule of Values:

1. Contractor must make a separate request for each major pay item that they would like to be paid for on a Schedule of Values basis.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 NOT USED

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 01 31 19
PRE-CONSTRUCTION CONFERENCE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: To help clarify construction contract administration procedures, the Engineer will conduct a Preconstruction Conference prior to start of the Work. Provide attendance by the designated personnel.

B. Related Work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

A. For those persons designated by the Contractor, his subcontractors, and suppliers to attend the Preconstruction Conference, provide required authority to commit the entities they represent to solutions agreed upon in the Conference.

1.03 SUBMITTALS:

A. To the maximum extent practicable, advise the Owner and the Engineer at least 24 hours in advance of the Conference as to items to be added to the agenda.

B. The Engineer will compile minutes of the Conference, and will furnish a copy of the minutes to the Contractor and required copies to the Owner. The Contractor may make and distribute such copies as he wishes.

1.04 PRECONSTRUCTION CONFERENCE:

A. The Conference will be scheduled to be held prior to the Owner issuing the Notice to Proceed.

B. Attendance:

1. Provide attendance by authorized representatives of the Contractor and major subcontractors.

2. The Engineer will advise other interested parties, including the Owner, and request their attendance.

C. Minimum agenda: Data will be distributed and discussed on:

1. Organizational arrangement of Contractor's forces and personnel, and those of subcontractors, materials suppliers, and the Engineer;

2. Channels and procedures for communication;

3. Construction schedule, including sequence of critical work;

4. Contract Documents, including distribution of required copies of Drawings and revisions;

5. Processing of Shop Drawings and other data submitted to the Engineer for review;

6. Processing of field decisions and Change Orders.

7. Rules and regulations governing performance of the Work; and

8. Procedures for safety and first aid, security, quality control, housekeeping, and related matters.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: To enable orderly review during progress of the Work, and to provide for systematic discussion of problems, the Engineer/Owner will conduct project meetings throughout the construction period.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

2. The Contractor's relations with his subcontractors and materials suppliers, and discussions relative thereto, are the Contractor's responsibility and normally are not part of project meetings content.

1.02 QUALITY ASSURANCE:

A. For those persons designated by the Contractor and/or Owner's representative to attend and participate in project meetings, provide required authority that does not require City Council approval to commit the Contractor to solutions agreed upon in the project meetings.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 MEETING SCHEDULE:

A. Except as noted below for the Preconstruction Meeting, project meetings will be held every other week.

B. Meetings will be held via Teams conference call or in person at the project site.

C. Coordinate as necessary to establish mutually acceptable schedule for meetings.

3.02 MEETING LOCATION:

A. The Owner will establish meeting location. To the maximum extent practicable, meetings will be held at the job site.

3.03 PROJECT MEETINGS:

A. Attendance:

1. To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout progress of the Work.

2. Owner.

3. Engineer and principal consultants.

4. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspect of the Work is involved.

5. Others as appropriate to agenda.

B. Minimum Agenda:

1. Current status relative to the schedule.

2. Review progress of the Work since last meeting, including status of submittals for approval.

3. Review progress of the Work planned for the next two periods.

4. Review schedule and identify problems which impede planned progress.

5. Develop corrective measures and procedures to regain planned schedule.

6. Review Pay Requests.

7. Determine if the next meeting should be in the field or via a Team conference call.

3.04 PRE-INSTALLATION CONFERENCES:

A. Where required in individual specification Section, convene a pre-installation conference at project site or other designed location. Notify Engineer in writing at least 4 days in advance of meeting.

B. Require attendance of parties directly affecting or affected by work of the specific Section.

C. Review conditions of installation, preparation and installation procedures, and coordination with related work.

END OF SECTION

SECTION 01 31 32
Geotechnical Investigation Report

PART 1 - GENERAL

1.01 SUBSURFACE AND PHYSICAL CONDITIONS

A. A copy of the Geotechnical Engineering Report "West U WWTP Improvements" Project Number 21-0277 prepared by Gorrondona Engineering Services, Inc. for the Owner is available for prospective bidders, and is provided as an attachment to this Project Manual.

B. This report is made available for the convenience of the Contractor for informational purposes only. It is expressly understood that neither the Owner nor the Engineer will be responsible for interpretations or conclusions drawn by the Contractor.

PART 2 - PRODUCTS

A. NOT USED

PART 3 - EXECUTION

A. NOT USED

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 01 31 46
TPDES Requirements

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Documentation to be prepared and signed by Contractor/Operator before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR150000 issued on February 8, 2018 (the Construction General Permit).
B. Implementation, maintenance inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other appropriate practices shown on the Drawings or specified elsewhere in the Contract.
C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with Project Manager prior to start of construction.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.03 DEFINITIONS

A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavation activities, as well as other construction related activities (e.g., stock piling of fill material, demolition).
B. Large Construction Activity: Project that:

1. disturbs five acres or more, or
2. disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.

C. Small Construction Activity: Project that:

1. disturbs one or more acres but less than five acres, or
2. are part of a larger common plan of development that will disturb at least 1 but less than 5 Acres.

1.04 TPDES OPERATOR:

A. Operator - The person or persons associated with a large or small construction activity that is either a primary or secondary as defined below:
B. Primary Operator - the person or persons associated with a large or small construction activity that meets either of the following two criteria:

1. the persons have operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications or the person or persons have day-to-day operational control of those activities at a construction site that are necessary to ensure compliance with a storm water pollution prevention plan (SWP3) for the site or other permit conditions (e.g., they are authorized

to direct workers at a site to carry out activities required by the SWP3 or comply with other permit conditions).

C. Secondary Operator -The person or entity, often the property owner, whose operational control is limited to:

1. the employment of other operators, such as a general contractor, to perform or supervise construction activities, or the ability to approve or disapprove changes to construction plans and specifications, but who does not have day-to-day on-site operational control over construction activities at the site.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 SITE SPECIFIC STORM WATER POLLUTION PREVENTION PLAN (SWP3)

A. Prepare a SWP3 following Part III of the Construction General Permit and the Storm Water Management Handbook for Construction Activities issued under City Ordinance Section 47-695(b). If conflicts exist between the Construction General Permit and the handbook, the more stringent requirements will apply.
B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.
C. Submit the SWP3 and any updates or revisions to Project Manager for review and address comments prior to commencing, or continuing, construction activities.

3.02 NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY

A. Fill out, sign, and date TCEQ Form 20022 (03/06/2018) Notice of Intent (NOI) for an Authorization for Stormwater Discharges Associated with Construction Activity under TPDES General Permit TXR150000, ATTACHMENT 1 of this Section 01 31 46.
B. Transmit the signed Contractor's copy of TCEQ Form 20022 (03/06/2018), along with a $325.00 check, made out to Texas Commission on Environmental Quality, and the completed Payment Submittal Form to Project Manager.
C. Project Manager will complete a separate TCEQ Form 20022 (03/06/2018) for City's permit.
D. Submission of the Notice of Intent form by both the City and Contractor to TCEQ if mailing is required a minimum of seven days before Commencement of Construction Activities.

3.03 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

A. Fill out, sign, and date the Construction Site Notice, Attachment 2 to TPDES General Permit TXR150000, "Small Construction Site Notice", ATTACHMENT 2 of this Section 01 31 46.
B. Transmit the signed Construction Site Notice to Project Manager at least seven days prior to Commencement of Construction Activity.

3.04 CERTIFICATION REQUIREMENTS

A. Fill out TPDES Operator's Information form, ATTACHMENT 3 of this Section 01 31 46, including Contractor's name, address, and telephone number, and the names of persons or firms responsible for maintenance and inspection of erosion and sediment control measures. Use multiple copies as required to document full information.

B. Contractor and Subcontractors shall sign and date the Contractor's / Subcontractor's Certification for TPDES Permitting, ATTACHMENT 4 of this Section 01 31 46. Include this certification with other Project certification forms.
C. Submit properly completed certification forms to Project Manager for review before
D. beginning construction operations.
E. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures read, fill out, sign, and date the Erosion Control Contractor's certification for Inspection and Maintenance. Use the Storm Water Pollution Prevention Plan, Construction Site Inspection Report, ATTACHMENT 5 of this Section 01 31 46 to record maintenance inspections and repairs.

3.05 RETENTION OF RECORDS

A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR150000). Contractors with day-to-day operational control over SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to Project Manager.

3.06 REQUIRED NOTICES

A. Post the following notices from effective date of the SWP3 until date of final site stabilization as defined in the Construction General Permit:

1. Post the TPDES permit number for Large Construction Activity, with a signed TCEQ Construction Site Notice for large or Small Construction Activity. Signed copies of the City's and Contractor's NOI must also be posted.
2. Post notices near the main entrance of the construction site in a prominent place where it is safely and readily available for viewing by General Public, Local, State, and Federal Authorities. Post name and telephone number of Contractor's local contact person, brief project description and location of the SWP3.
3. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with Project Manager to conform to requirements of the Construction General Permit.
4. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.
5. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction access area.
6. Post a notice of waste disposal procedures in a readily visible location on site.

3.07 ON-SITE WASTE MATERIAL STORAGE

A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.
B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SWP3.

C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWP3.

3.08 NOTICE OF TERMINATION

A. Submit a NOT, ATTACHMENT 6 of this Section 01 31 46, to Project Manager within 30 days after:

1. Final stabilization has been achieved on all portions of the site.
2. Another operator has assumed control over all areas of the site that have not been stabilized.
3. All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage.

B. Project Manager will complete City's NOT and submit Contractor and City's notices to the TCEQ and MS4 entities.

END OF SECTION

ATTACHMENT 1

TCEQ Office Use Only
Permit No:
CN:
RN:

Notice of Intent (NOI) for an Authorization for Stormwater Discharges Associated with Construction Activity under TPDES General Permit TXR150000

IMPORTANT INFORMATION

Please read and use the General Information and Instructions prior to filling out each question in the NOI form.

Use the NOI Checklist to ensure all required information is completed correctly. **Incomplete applications delay approval or result in automatic denial.**

Once processed your permit authorization can be viewed by entering the following link into your internet browser: http://www2.tceq.texas.gov/wq_dpa/index.cfm or you can contact TCEQ Stormwater Processing Center at 512-239-3700.

ePERMITS

Effective September 1, 2018, this paper form must be submitted to TCEQ with a completed electronic reporting waiver form (TCEQ-20754).

To submit an NOI electronically, enter the following web address into your internet browser and follow the instructions: https://www3.tceq.texas.gov/steers/index.cfm

APPLICATION FEE AND PAYMENT

The application fee for submitting a paper NOI is $325. The application fee for electronic submittal of a NOI through the TCEQ ePermits system (STEERS) is $225.

Payment of the application fee can be submitted by mail or through the TCEQ ePay system. The payment and the NOI must be mailed to separate addresses. To access the TCEQ ePay system enter the following web address into your internet browser: http://www.tceq.texas.gov/epay.

Provide your payment information for verification of payment:

- If payment was mailed to TCEQ, provide the following:
  - Check/Money Order Number:
  - Name printed on Check:
- If payment was made via ePay, provide the following:
  - Voucher Number:
  - A copy of the payment voucher is attached to this paper NOI form.

TCEQ-20022 (3/6/2018)
Notice of Intent for Construction Stormwater Discharges under TXR150000 Page 1

ATTACHMENT 1

TCEQ Office Use Only
Permit No:
CN:
RN:

Notice of Intent (NOI) for an Authorization for Stormwater Discharges Associated with Construction Activity under TPDES General Permit TXR150000

IMPORTANT INFORMATION

Please read and use the General Information and Instructions prior to filling out each question in the NOI form.

Use the NOI Checklist to ensure all required information is completed correctly. **Incomplete applications delay approval or result in automatic denial.**

Once processed your permit authorization can be viewed by entering the following link into your internet browser: http://www2.tceq.texas.gov/wq_dpa/index.cfm or you can contact TCEQ Stormwater Processing Center at 512-239-3700.

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To submit an NOI electronically, enter the following web address into your internet browser and follow the instructions: https://www3.tceq.texas.gov/steers/index.cfm

APPLICATION FEE AND PAYMENT

The application fee for submitting a paper NOI is $325. The application fee for electronic submittal of a NOI through the TCEQ ePermits system (STEERS) is $225.

Payment of the application fee can be submitted by mail or through the TCEQ ePay system. The payment and the NOI must be mailed to separate addresses. To access the TCEQ ePay system enter the following web address into your internet browser: http://www.tceq.texas.gov/epay.

Provide your payment information for verification of payment:

- If payment was mailed to TCEQ, provide the following:
  - Check/Money Order Number:
  - Name printed on Check:
- If payment was made via ePay, provide the following:
  - Voucher Number:
  - A copy of the payment voucher is attached to this paper NOI form.

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RENEWAL (This portion of the NOI is not applicable after June 3, 2018)

Is this NOI for a renewal of an existing authorization? ☐ Yes ☐ No

If Yes, provide the authorization number here: TXR15

NOTE: If an authorization number is not provided, a new number will be assigned.

SECTION 1. OPERATOR (APPLICANT)

a) If the applicant is currently a customer with TCEQ, what is the Customer Number (CN) issued to this entity? CN

(Refer to Section 1.a) of the Instructions)

b) What is the Legal Name of the entity (applicant) applying for this permit? (The legal name must be spelled exactly as filed with the Texas Secretary of State, County, or in the legal document forming the entity.)

c) What is the contact information for the Operator (Responsible Authority)?

Prefix (Mr. Ms. Miss):

First and Last Name: Suffix:

Title: Credentials:

Phone Number: Fax Number:

E-mail:

Mailing Address:

City, State, and Zip Code:

Mailing Information if outside USA:

Territory:

Country Code: Postal Code:

d) Indicate the type of customer:

☐ Individual
☐ Limited Partnership
☐ General Partnership
☐ Trust
☐ Sole Proprietorship (D.B.A.)
☐ Corporation
☐ Estate
☐ Federal Government
☐ County Government
☐ State Government
☐ City Government
☐ Other Government
☐ Other:

e) Is the applicant an independent operator? ☐ Yes ☐ No

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(If a governmental entity, a subsidiary, or part of a larger corporation, check No.)

f) Number of Employees. Select the range applicable to your company.

☐ 0-20 ☐ 251-500

☐ 21-100 ☐ 501 or higher

☐ 101-250

g) Customer Business Tax and Filing Numbers: (**Required** for Corporations and Limited Partnerships. **Not Required** for Individuals, Government, or Sole Proprietors.)

State Franchise Tax ID Number:

Federal Tax ID:

Texas Secretary of State Charter (filing) Number:

DUNS Number (if known):

SECTION 2. APPLICATION CONTACT

Is the application contact the same as the applicant identified above?

☐ Yes, go to Section 3

☐ No, complete this section

Prefix (Mr. Ms. Miss):

First and Last Name: Suffix:

Title: Credential:

Organization Name:

Phone Number: Fax Number:

E-mail:

Mailing Address:

Internal Routing (Mail Code, Etc.):

City, State, and Zip Code:

Mailing information if outside USA:

Territory:

Country Code: Postal Code:

SECTION 3. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

a) If this is an existing permitted site, what is the Regulated Entity Number (RN) issued to this site? RN

(Refer to Section 3.a) of the Instructions)

b) Name of project or site (the name known by the community where it's located):

c) In your own words, briefly describe the type of construction occurring at the regulated site (residential, industrial, commercial, or other):

d) County or Counties (if located in more than one):

e) Latitude: Longitude:

f) Site Address/Location

If the site has a physical address such as 12100 Park 35 Circle, Austin, TX 78753, complete *Section A*.

If the site does not have a physical address, provide a location description in *Section B*. Example: located on the north side of FM 123, 2 miles west of the intersection of FM 123 and Highway 1.

Section A:

Street Number and Name:

City, State, and Zip Code:

Section B:

Location Description:

City (or city nearest to) where the site is located:

Zip Code where the site is located:

SECTION 4. GENERAL CHARACTERISTICS

a) Is the project or site located on Indian Country Lands?

☐ Yes, do not submit this form. You must obtain authorization through EPA Region 6.

☐ No

b) Is your construction activity associated with a facility that, when completed, would be associated with the exploration, development, or production of oil or gas or geothermal resources?

☐ Yes. Note: The construction stormwater runoff may be under jurisdiction of the Railroad Commission of Texas and may need to obtain authorization through EPA Region 6.

☐ No

c) What is the Primary Standard Industrial Classification (SIC) Code that best describes the construction activity being conducted at the site?

d) What is the Secondary SIC Code(s), if applicable?

e) What is the total number of acres to be disturbed?

f) Is the project part of a larger common plan of development or sale?

☐ Yes

☐ No. The total number of acres disturbed, provided in e) above, must be 5 or more. If the total number of acres disturbed is less than 5, do not submit this form. See the requirements in the general permit for small construction sites.

g) What is the estimated start date of the project?

h) What is the estimated end date of the project?

i) Will concrete truck washout be performed at the site? ☐ Yes ☐ No

j) What is the name of the first water body(ies) to receive the stormwater runoff or potential runoff from the site?

k) What is the segment number(s) of the classified water body(ies) that the discharge will eventually reach?

l) Is the discharge into a Municipal Separate Storm Sewer System (MS4)?

☐ Yes ☐ No

If Yes, provide the name of the MS4 operator:

Note: The general permit requires you to send a copy of this NOI form to the MS4 operator.

m) Is the discharge or potential discharge from the site within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer, as defined in 30 TAC Chapter 213?

☐ Yes, complete the certification below.

☐ No, go to Section 5

I certify that the copy of the TCEQ-approved Plan required by the Edwards Aquifer Rule (30 TAC Chapter 213) that is included or referenced in the Stormwater Pollution Prevention Plan will be implemented. ☐ Yes

SECTION 5. NOI CERTIFICATION

a) I certify that I have obtained a copy and understand the terms and conditions of the Construction General Permit (TXR150000). ☐ Yes

b) I certify that the full legal name of the entity applying for this permit has been provided and is legally authorized to do business in Texas. ☐ Yes

c) I understand that a Notice of Termination (NOT) must be submitted when this authorization is no longer needed. ☐ Yes

d) I certify that a Stormwater Pollution Prevention Plan has been developed, will be implemented prior to construction and to the best of my knowledge and belief is compliant with any applicable local sediment and erosion control plans, as required in the Construction General Permit (TXR150000). ☐ Yes

Note: For multiple operators who prepare a shared SWP3, the confirmation of an operator may be limited to its obligations under the SWP3, provided all obligations are confirmed by at least one operator.

SECTION 6. APPLICANT CERTIFICATION SIGNATURE

Operator Signatory Name:

Operator Signatory Title:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under 30 Texas Administrative Code §305.44 to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature (use blue ink):_____Date: _____

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Notice of Intent for Construction Stormwater Discharges under TXR150000 Page 6

NOTICE OF INTENT CHECKLIST (TXR150000)

Did you complete everything? Use this checklist to be sure!

Are you ready to mail your form to TCEQ? Go to the General Information Section of the Instructions for mailing addresses.

Confirm each item (or applicable item) in this form is complete. This checklist is for use by the applicant to ensure a complete application is being submitted. **Missing information may result in denial of coverage under the general permit.** (See NOI process description in the General Information and Instructions.)

APPLICATION FEE

If paying by check:

☐ Check was mailed **separately** to the TCEQs Cashier's Office. (See Instructions for Cashier's address and Application address.)

☐ Check number and name on check is provided in this application.

If using ePay:

☐ The voucher number is provided in this application and a copy of the voucher is attached.

RENEWAL

☐ If this application is for renewal of an existing authorization, the authorization number is provided.

OPERATOR INFORMATION

☐ Customer Number (CN) issued by TCEQ Central Registry

☐ Legal name as filed to do business in Texas. (Call TX SOS 512-463-5555 to verify.)

☐ Name and title of responsible authority signing the application.

☐ Phone number and e-mail address

☐ Mailing address is complete & verifiable with USPS. www.usps.com

☐ Type of operator (entity type). Is applicant an independent operator?

☐ Number of employees.

☐ For corporations or limited partnerships – Tax ID and SOS filing numbers.

☐ Application contact and address is complete & verifiable with USPS. http://www.usps.com

REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

☐ Regulated Entity Number (RN) (if site is already regulated by TCEQ)

☐ Site/project name and construction activity description

☐ County

☐ Latitude and longitude http://www.tceq.texas.gov/gis/sqmaview.html

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☐ Site Address/Location. Do not use a rural route or post office box.

GENERAL CHARACTERISTICS

☐ Indian Country Lands –the facility is not on Indian Country Lands.

☐ Construction activity related to facility associated to oil, gas, or geothermal resources

☐ Primary SIC Code that best describes the construction activity being conducted at the site. www.osha.gov/oshstats/sicser.html

☐ Estimated starting and ending dates of the project.

☐ Confirmation of concrete truck washout.

☐ Acres disturbed is provided and qualifies for coverage through a NOI.

☐ Common plan of development or sale.

☐ Receiving water body or water bodies.

☐ Segment number or numbers.

☐ MS4 operator.

☐ Edwards Aquifer rule.

CERTIFICATION

☐ Certification statements have been checked indicating Yes.

☐ Signature meets 30 Texas Administrative Code (TAC) §305.44 and is original.

Instructions for Notice of Intent (NOI) for Stormwater Discharges Associated with Construction Activity under TPDES General Permit (TXR150000)

GENERAL INFORMATION

Where to Send the Notice of Intent (NOI):

By Regular Mail:
TCEQ
Stormwater Processing Center (MC228)
P.O. Box 13087
Austin, Texas 78711-3087

By Overnight or Express Mail:
TCEQ
Stormwater Processing Center (MC228)
12100 Park 35 Circle
Austin, TX

Application Fee:

The application fee of $325 is required to be paid at the time the NOI is submitted. Failure to submit payment at the time the application is filed will cause delays in acknowledgment or denial of coverage under the general permit. Payment of the fee may be made by check or money order, payable to TCEQ, or through EPAY (electronic payment through the web).

Mailed Payments:

Use the attached General Permit Payment Submittal Form. The application fee is submitted to a different address than the NOI. Read the General Permit Payment Submittal Form for further instructions, including the address to send the payment.

ePAY Electronic Payment: http://www.tceq.texas.gov/epay

When making the payment you must select Water Quality, and then select the fee category "General Permit Construction Storm Water Discharge NOI Application". You must include a copy of the payment voucher with your NOI. Your NOI will not be considered complete without the payment voucher.

TCEQ Contact List:

Application – status and form questions:	512-239-3700, swpermit@tceq.texas.gov
Technical questions:	512-239-4671, swgp@tceq.texas.gov
Environmental Law Division:	512-239-0600
Records Management - obtain copies of forms:	512-239-0900
Reports from databases (as available):	512-239-DATA (3282)
Cashier's office:	512 239-0357 or 512-239-0187

Notice of Intent Process:

When your NOI is received by the program, the form will be processed as follows:

- **Administrative Review**: Each item on the form will be reviewed for a complete response. In addition, the operator's legal name must be verified with Texas Secretary of State as valid and active (if applicable). The address(es) on the form must be verified with the US Postal service as receiving regular mail delivery. Do not give an overnight/express mailing address..

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Instructions for Notice of Intent for TPDES General Permit TXR150000

- **Notice of Deficiency:** If an item is incomplete or not verifiable as indicated above, a notice of deficiency (NOD) will be mailed to the operator. The operator will have 30 days to respond to the NOD. The response will be reviewed for completeness.
- **Acknowledgment of Coverage:** An Acknowledgment Certificate will be mailed to the operator. This certificate acknowledges coverage under the general permit.

  or

  Denial of Coverage: If the operator fails to respond to the NOD or the response is inadequate, coverage under the general permit may be denied. If coverage is denied, the operator will be notified.

General Permit (Your Permit)

For NOIs submitted **electronically** through ePermits, provisional coverage under the general permit begins immediately following confirmation of receipt of the NOI form by the TCEQ.

For **paper** NOIs, provisional coverage under the general permit begins **7 days after a completed NOI is postmarked for delivery** to the TCEQ.

You should have a copy of your general permit when submitting your application. You may view and print your permit for which you are seeking coverage, on the TCEQ web site http://www.tceq.texas.gov. Search using keyword TXR150000.

Change in Operator

An authorization under the general permit is not transferable. If the operator of the regulated project or site changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted no later than 10 days prior to the change in Operator status.

TCEQ Central Registry Core Data Form

The Core Data Form has been incorporated into this form. Do not send a Core Data Form to TCEQ. After final acknowledgment of coverage under the general permit, the program will assign a Customer Number and Regulated Entity Number, if one has not already been assigned to this customer or site.

For existing customers and sites, you can find the Customer Number and Regulated Entity Number by entering the following web address into your internet browser: http://www15.tceq.texas.gov/crpub/ or you can contact the TCEQ Stormwater Processing Center at 512-239-3700 for assistance. On the website, you can search by your permit number, the Regulated Entity (RN) number, or the Customer Number (CN). If you do not know these numbers, you can select "Advanced Search" to search by permittee name, site address, etc.

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorizations as changes occur. For this permit, a Notice of Change form must be submitted to the program area.

INSTRUCTIONS FOR FILLING OUT THE NOI FORM

Renewal of General Permit. Dischargers holding active authorizations under the expired General Permit are required to submit a NOI to continue coverage. The existing permit number is required. If the permit number is not provided or has been terminated, expired, or denied, a new permit number will be issued.

Section 1. OPERATOR (APPLICANT)

a) Customer Number (CN)

TCEQ's Central Registry will assign each customer a number that begins with CN, followed by nine digits. **This is not a permit number, registration number, or license number.**

If the applicant is an existing TCEQ customer, the Customer Number is available at the following website: http://www15.tceq.texas.gov/crpub/. If the applicant is not an existing TCEQ customer, leave the space for CN blank.

b) Legal Name of Applicant

Provide the current legal name of the applicant. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, as filed in the county. You may contact the SOS at 512-463-5555, for more information related to filing in Texas. If filed in the county, provide a copy of the legal documents showing the legal name.

c) Contact Information for the Applicant (Responsible Authority)

Provide information for the person signing the application in the Certification section. This person is also referred to as the Responsible Authority.

Provide a complete mailing address for receiving mail from the TCEQ. The mailing address must be recognized by the US Postal Service. You may verify the address on the following website: https://tools.usps.com/go/ZipLookupAction!input.action.

The phone number should provide contact to the applicant.

The fax number and e-mail address are optional and should correspond to the applicant.

d) Type of Customer (Entity Type)

Check only one box that identifies the type of entity. Use the descriptions below to identify the appropriate entity type. Note that the selected entity type also indicates the name that must be provided as an applicant for an authorization.

Individual

An individual is a customer who has not established a business, but conducts an activity that needs to be regulated by the TCEQ.

Partnership

A customer that is established as a partnership as defined by the Texas Secretary of State Office (TX SOS). If the customer is a 'General Partnership' or 'Joint Venture' filed in the county (not filed with TX SOS), the legal name of each partner forming the 'General Partnership' or 'Joint Venture' must be provided. Each 'legal entity' must apply as a co-applicant.

Trust or Estate

A trust and an estate are fiduciary relationships governing the trustee/executor with respect to the trust/estate property.

Sole Proprietorship (DBA)

A sole proprietorship is a customer that is owned by only one person and has not been incorporated. This business may:

1. be under the person's name
2. have its own name (doing business as or DBA)
3. have any number of employees.

If the customer is a Sole Proprietorship or DBA, the 'legal name' of the individual business 'owner' must be provided. The DBA name is not recognized as the 'legal name' of the entity. The DBA name may be used for the site name (regulated entity).

Corporation

A customer that meets all of these conditions:

1. is a legally incorporated entity under the laws of any state or country
2. is recognized as a corporation by the Texas Secretary of State
3. has proper operating authority to operate in Texas

The corporation's 'legal name' as filed with the Texas Secretary of State must be provided as applicant. An 'assumed' name of a corporation is not recognized as the 'legal name' of the entity.

Government

Federal, state, county, or city government (as appropriate)

The customer is either an agency of one of these levels of government or the governmental body itself. The government agency's 'legal name' must be provided as the applicant. A department name or other description of the organization is not recognized as the 'legal name'.

Other

This may include a utility district, water district, tribal government, college district, council of governments, or river authority. Provide the specific type of government.

e) Independent Entity

Check No if this customer is a subsidiary, part of a larger company, or is a governmental entity. Otherwise, check Yes.

f) Number of Employees

Check one box to show the number of employees for this customer's entire company, at all locations. This is not necessarily the number of employees at the site named in the application.

g) **Customer Business Tax and Filing Numbers**

These are required for Corporations and Limited Partnerships. These are not required for Individuals, Government, and Sole Proprietors.

State Franchise Tax ID Number

Corporations and limited liability companies that operate in Texas are issued a franchise tax identification number. If this customer is a corporation or limited liability company, enter the Tax ID number.

Federal Tax ID

All businesses, except for some small sole proprietors, individuals, or general partnerships should have a federal taxpayer identification number (TIN). Enter this number here. Use no prefixes, dashes, or hyphens. Sole proprietors, individuals, or general partnerships do not need to provide a federal tax ID.

TX SOS Charter (filing) Number

Corporations and Limited Partnerships required to register with the Texas Secretary of State are issued a charter or filing number. You may obtain further information by calling SOS at 512-463-5555.

DUNS Number

Most businesses have a DUNS (Data Universal Numbering System) number issued by Dun and Bradstreet Corp. If this customer has one, enter it here.

Section 2. APPLICATION CONTACT

Provide the name and contact information for the person that TCEQ can contact for additional information regarding this application.

Section 3. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

a) **Regulated Entity Number (RN)**

The RN is issued by TCEQ's Central Registry to sites where an activity is regulated by TCEQ. This is not a permit number, registration number, or license number. Search TCEQ's Central Registry to see if the site has an assigned RN at http://www15.tceq.texas.gov/crpub/. If this regulated entity has not been assigned an RN, leave this space blank.

If the site of your business is part of a larger business site, an RN may already be assigned for the larger site. Use the RN assigned for the larger site.

If the site is found, provide the assigned RN and provide the information for the site to be authorized through this application. The site information for this authorization may vary from the larger site information.

An example is a chemical plant where a unit is owned or operated by a separate corporation that is accessible by the same physical address of your unit or facility. Other examples include industrial parks identified by one common address but different corporations have control of defined areas within the site. In both cases, an RN would be assigned for the physical address location and the permitted sites would be identified separately under the same RN.

b) Name of the Project or Site

Provide the name of the site or project as known by the public in the area where the site is located. The name you provide on this application will be used in the TCEQ Central Registry as the Regulated Entity name.

c) Description of Activity Regulated

In your own words, briefly describe the primary business that you are doing that requires this authorization. Do not repeat the SIC Code description.

d) County

Provide the name of the county where the site or project is located. If the site or project is located in more than one county, provide the county names as secondary.

e) Latitude and Longitude

Enter the latitude and longitude of the site in degrees, minutes, and seconds or decimal form. For help obtaining the latitude and longitude, go to: http://www.tceq.texas.gov/gis/sqmaview.html.

f) Site Address/Location

If a site has an address that includes a street number and street name, enter the complete address for the site in *Section A*. If the physical address is not recognized as a USPS delivery address, you may need to validate the address with your local police (911 service) or through an online map site used to locate a site. Please confirm this to be a complete and valid address. Do not use a rural route or post office box for a site location.

If a site does not have an address that includes a street number and street name, provide a complete written location description in *Section B*. For example: "The site is located on the north side of FM 123, 2 miles west of the intersection of FM 123 and Highway 1."

Provide the city (or nearest city) and zip code of the site location.

Section4. GENERAL CHARACTERISTICS

a) Indian Country Lands

If your site is located on Indian Country Lands, the TCEQ does not have authority to process your application. You must obtain authorization through EPA Region 6, Dallas. Do not submit this form to TCEQ.

b) Construction activity associated with facility associated with exploration, development, or production of oil, gas, or geothermal resources

If your activity is associated with oil and gas exploration, development, or production, you may be under jurisdiction of the Railroad Commission of Texas (RRC) and may need to obtain authorization from EPA Region 6.

Construction activities associated with a facility related to oil, gas or geothermal resources may include the construction of a well site; treatment or storage facility; underground hydrocarbon or natural gas storage facility; reclamation plant; gas processing facility; compressor station; terminal facility where crude oil is stored prior to refining and at which refined products are stored solely for use at the facility; a

carbon dioxide geologic storage facility; and a gathering, transmission, or distribution pipeline that will transport crude oil or natural gas, including natural gas liquids, prior to refining of such oil or the use of the natural gas in any manufacturing process or as a residential or industrial fuel.

Where required by federal law, discharges of stormwater associated with construction activities under the RRC's jurisdiction must be authorized by the EPA and the RRC, as applicable. Activities under RRC jurisdiction include construction of a facility that, when completed, would be associated with the exploration, development, or production of oil or gas or geothermal resources, such as a well site; treatment or storage facility; underground hydrocarbon or natural gas storage facility; reclamation plant; gas processing facility; compressor station; terminal facility where crude oil is stored prior to refining and at which refined products are stored solely for use at the facility; a carbon dioxide geologic storage facility under the jurisdiction of the RRC; and a gathering, transmission, or distribution pipeline that will transport crude oil or natural gas, including natural gas liquids, prior to refining of such oil or the use of the natural gas in any manufacturing process or as a residential or industrial fuel. The RRC also has jurisdiction over stormwater from land disturbance associated with a site survey that is conducted prior to construction of a facility that would be regulated by the RRC. Under 33 U.S.C. §1342(l)(2) and §1362(24), EPA cannot require a permit for discharges of stormwater from field activities or operations associated with {oil and gas} exploration, production, processing, or treatment operations, or transmission facilities, including activities necessary to prepare a site for drilling and for the movement and placement of drilling equipment, whether or not such field activities or operations may be considered to be construction activities unless the discharge is contaminated by contact with any overburden, raw material, intermediate product, finished product, byproduct, or waste product located on the site of the facility. Under §3.8 of this title (relating to Water Protection), the RRC prohibits operators from causing or allowing pollution of surface or subsurface water. Operators are encouraged to implement and maintain best management practices (BMPs) to minimize discharges of pollutants, including sediment, in stormwater during construction activities to help ensure protection of surface water quality during storm events.

For more information about the jurisdictions of the RRC and the TCEQ, read the Memorandum of Understanding (MOU) between the RRC and TCEQ at 16 Texas Administrative Code, Part 1, Chapter 3, Rule 3.30, by entering the following link into an internet browser: http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=16&pt=1&ch=3&rl=30 or contact the TCEQ Stormwater Team at 512-239-4671 for additional information.

c) Primary Standard Industrial Classification (SIC) Code

Provide the SIC Code that best describes the construction activity being conducted at this site.

Common SIC Codes related to construction activities include:

- 1521 - Construction of Single Family Homes
- 1522 - Construction of Residential Buildings Other than Single Family Homes
- 1541 - Construction of Industrial Buildings and Warehouses

- 1542 - Construction of Non-residential Buildings, other than Industrial Buildings and Warehouses
- 1611 - Highway and Street Construction, except Highway Construction
- 1622 - Bridge, Tunnel, and Elevated Highway Construction
- 1623 - Water, Sewer, Pipeline and Communications, and Power Line Construction

For help with SIC Codes, enter the following link into your internet browser: http://www.osha.gov/pls/imis/sicsearch.html or you can contact the TCEQ Small Business and Local Government Assistance Section at 800-447-2827 for assistance.

d) Secondary SIC Code

Secondary SIC Code(s) may be provided. Leave this blank if not applicable. For help with SIC Codes, enter the following link into your internet browser: http://www.osha.gov/pls/imis/sicsearch.html or you can contact the TCEQ Small Business and Environmental Assistance Section at 800-447-2827 for assistance.

e) Total Number of Acres Disturbed

Provide the approximate number of acres that the construction site will disturb. Construction activities that disturb less than one acre, unless they are part of a larger common plan that disturbs more than one acre, do not require permit coverage. Construction activities that disturb between one and five acres, unless they are part of a common plan that disturbs more than five acres, do not require submission of an NOI. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres. Disturbed means any clearing, grading, excavating, or other similar activities.

If you have any questions about this item, please contact the stormwater technical staff by phone at 512-239-4671 or by email at swgp@tceq.texas.gov.

f) Common Plan of Development

Construction activities that disturb less than five acres do not require submission of an NOI unless they are part of a common plan of development or for sale where the area disturbed is five or more acres. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres. Disturbed means any clearing, grading, excavating, or other similar activities.

For more information on what a common plan of development is, refer to the definition of "Common Plan of Development" in the Definitions section of the general permit or enter the following link into your internet browser: www.tceq.texas.gov/permitting/stormwater/common_plan_of_development_steps.html

For further information, go to the TCEQ stormwater construction webpage enter the following link into your internet browser: www.tceq.texas.gov/goto/construction and search for "Additional Guidance and Quick Links". If you have any further questions about the Common Plan of Development you can contact the TCEQ Stormwater Team at 512-239-4671 or the TCEQ Small Business and Environmental Assistance at 800-447-2827.

g) Estimated Start Date of the Project

This is the date that any construction activity or construction support activity is initiated at the site. If renewing the permit provide the original start date of when construction activity for this project began.

h) Estimated End Date of the Project

This is the date that any construction activity or construction support activity will end and final stabilization will be achieved at the site.

i) Will concrete truck washout be performed at the site?

Indicate if you expect that operators of concrete trucks will washout concrete trucks at the construction site.

j) Identify the water body(s) receiving stormwater runoff

The stormwater may be discharged directly to a receiving stream or through a MS4 from your site. It eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. You must provide the name of the water body that receives the discharge from the site (a local stream or lake).

If your site has more than one outfall you need to include the name of the first water body for each outfall, if they are different.

k) Identify the segment number(s) of the classified water body(s)

Identify the classified segment number(s) receiving a discharge directly or indirectly. Enter the following link into your internet browser to find the segment number of the classified water body where stormwater will flow from the site: www.tceq.texas.gov/waterquality/monitoring/viewer.html or by contacting the TCEQ Water Quality Division at (512) 239-4671 for assistance.

You may also find the segment number in TCEQ publication GI-316 by entering the following link into your internet browser: www.tceq.texas.gov/publications/gi/gi-316 or by contacting the TCEQ Water Quality Division at (512) 239-4671 for assistance.

If the discharge is into an unclassified receiving water and then crosses state lines prior to entering a classified segment, select the appropriate watershed:

- 0100 (Canadian River Basin)
- 0200 (Red River Basin)
- 0300 (Sulfur River Basin)
- 0400 (Cypress Creek Basin)
- 0500 (Sabine River Basin)

Call the Water Quality Assessments section at 512-239-4671 for further assistance.

l) Discharge into MS4 – Identify the MS4 Operator

The discharge may initially be into a municipal separate storm sewer system (MS4). If the stormwater discharge is into an MS4, provide the name of the entity that operates the MS4 where the stormwater discharges. An MS4 operator is often a city, town, county, or utility district, but possibly can be another form of government. Please note that the Construction General Permit requires the Operator to supply the MS4 with a

copy of the NOI submitted to TCEQ. For assistance, you may call the technical staff at 512-239-4671.

m) Discharges to the Edwards Aquifer Recharge Zone and Certification

The general permit requires the approved Contributing Zone Plan or Water Pollution Abatement Plan to be included or referenced as a part of the Stormwater Pollution Prevention Plan.

See maps on the TCEQ website to determine if the site is located within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer by entering the following link into an internet browser: www.tceq.texas.gov/field/eapp/viewer.html or by contacting the TCEQ Water Quality Division at 512-239-4671 for assistance.

If the discharge or potential discharge is within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer, a site-specific authorization approved by the Executive Director under the Edwards Aquifer Protection Program (30 TAC Chapter 213) is required before construction can begin.

For questions regarding the Edwards Aquifer Protection Program, contact the appropriate TCEQ Regional Office. For projects in Hays, Travis and Williamson Counties: Austin Regional Office, 12100 Park 35 Circle, Austin, TX 78753, 512-339-2929. For Projects in Bexar, Comal, Kinney, Medina and Uvalde Counties: TCEQ San Antonio Regional Office, 14250 Judson Rd., San Antonio, TX 78233-4480, 210-490-3096.

Section 5. NOI CERTIFICATION

Note: Failure to indicate Yes to all of the certification items may result in denial of coverage under the general permit.

a) Certification of Understanding the Terms and Conditions of Construction General Permit (TXR150000)

Provisional coverage under the Construction General Permit (TXR150000) begins 7 days after the completed paper NOI is postmarked for delivery to the TCEQ. Electronic applications submitted through ePermits have immediate provisional coverage. You must obtain a copy and read the Construction General Permit before submitting your application. You may view and print the Construction General Permit for which you are seeking coverage at the TCEQ web site by entering the following link into an internet browser: www.tceq.texas.gov/goto/construction or you may contact the TCEQ Stormwater processing Center at 512-239-3700 for assistance.

b) Certification of Legal Name

The full legal name of the applicant as authorized to do business in Texas is required. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, that is filed in the county where doing business. You may contact the SOS at 512-463 5555, for more information related to filing in Texas.

c) Understanding of Notice of Termination

A permittee shall terminate coverage under the Construction General Permit through the submittal of a NOT when the operator of the facility changes, final stabilization has

been reached, the discharge becomes authorized under an individual permit, or the construction activity never began at this site.

d) Certification of Stormwater Pollution Prevention Plan

The SWP3 identifies the areas and activities that could produce contaminated runoff at your site and then tells how you will ensure that this contamination is mitigated. For example, in describing your mitigation measures, your site's plan might identify the devices that collect and filter stormwater, tell how those devices are to be maintained, and tell how frequently that maintenance is to be carried out. You must develop this plan in accordance with the TCEQ general permit requirements. This plan must be developed and implemented before you complete this NOI. The SWP3 must be available for a TCEQ investigator to review on request.

Section 6. APPLICANT CERTIFICATION SIGNATURE

The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code (TAC) §305.44.

If you are a corporation:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

If you are a municipality or other government entity:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to §305.44(a)(3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the TCEQ's Environmental Law Division at 512-239-0600.

30 Texas Administrative Code

§305.44. Signatories to Applications

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the

corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

Texas Commission on Environmental Quality
General Permit Payment Submittal Form

Use this form to submit your Application Fee only if you are mailing your payment.

Instructions:

- Complete items 1 through 5 below:
- Staple your check in the space provided at the bottom of this document.
- *Do not mail this form with your NOI form.*
- *Do not mail this form to the same address as your NOI.*

Mail this form and your check to either of the following:

By Regular U.S. Mail
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
P.O. Box 13088
Austin, TX 78711-3088

By Overnight or Express Mail
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
12100 Park 35 Circle
Austin, TX 78753

Fee Code: GPA General Permit: TXR150000

1. Check or Money Order No:
2. Amount of Check/Money Order:
3. Date of Check or Money Order:
4. Name on Check or Money Order:
5. NOI Information:

   If the check is for more than one NOI, list each Project or Site (RE) Name and Physical Address exactly as provided on the NOI. **Do not submit a copy of the NOI with this form, as it could cause duplicate permit application entries!**

   If there is not enough space on the form to list all of the projects or sites the authorization will cover, then attach a list of the additional sites.

   Project/Site (RE) Name:

   Project/Site (RE) Physical Address:

Staple the check or money order to this form in this space.

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ATTACHMENT 2

SMALL CONSTRUCTION SITE NOTICE

FOR THE
Texas Commission on Environmental Quality (TCEQ)
Stormwater Program

TPDES GENERAL PERMIT TXR150000

The following information is posted in compliance with **Part II.E.2.** of the TCEQ General Permit Number TXR150000 for discharges of stormwater runoff from small construction sites. Additional information regarding the TCEQ stormwater permit program may be found on the internet at:

http://www.tceq.state.tx.us/nav/permits/wq_construction.html

Operator Name:	
Contact Name and Phone Number:	
Project Description: *Physical address or description of the site's location, estimated start date and projected end date, or date that disturbed soils will be stabilized*	
Location of Stormwater Pollution Prevention Plan:	

For Small Construction Activities Authorized Under Part II.E.2. (Obtaining Authorization to Discharge) the following certification must be completed:

I_____(Typed or Printed Name Person Completing This Certification) certify under penalty of law that I have read and understand the eligibility requirements for claiming an authorization under Part II.E.2. of TPDES General Permit TXR150000 and agree to comply with the terms of this permit. A stormwater pollution prevention plan has been developed and will be implemented prior to construction, according to permit requirements. A copy of this signed notice is supplied to the operator of the MS4 if discharges enter an MS4. I am aware there are significant penalties for providing false information or for conducting unauthorized discharges, including the possibility of fine and imprisonment for knowing violations.

Signature and Title_____Date _____

_____ *Date Notice Removed*

____*MS4 operator notified per Part II.F.3.*

ATTACHMENT 3

TPDES OPERATOR'S INFORMATION

Owner's Name and Address: City of Houston

Mr.
(City Official)

(Department)
1002 Washington Ave, 2nd FL
Houston, TX 77002
(832) 394-9108

Contractors' Names and Addresses:

General Contractor: _____

Telephone: _____

Site Superintendent: _____

Telephone: _____

Erosion Control and Maintenance Inspection: _____

Telephone: _____

Subcontractors' Names and Addresses:

_____ _____

Phone: _____ Phone: _____

Note: Insert name, address, and telephone number of person or firms

ATTACHMENT 4

CONTRACTOR'S / SUBCONTRACTOR'S

CERTIFICATION FOR TPDES PERMITTING

I certify under penalty of law that I understand the terms and conditions of TPDES General Permit No. TXR150000 and the Storm Water Pollution Prevention Plan for the construction site identified as part of this certification.

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

ATTACHMENT 5

City of Houston

Storm Water Quality
Construction Site Activities Inspection Report

TCEQ Stormwater Discharge Permit Number _____

COH Storm Water Quality Permit Number _____

COH Building Permit Login Number _____

NAME _____ DATE _____

ADDRESS _____

- ❑ No exceptions noted.

The following deficiencies have been noted:

- ❑ NOI / Construction Site Notice Improperly Posted
- ❑ Stormwater Pollution Prevention Plan Incomplete or requires updating
- ❑ Copy of NOI / CSN not on site
- ❑ Storm Water Pollution Prevention Plan not on site
- ❑ Erosion and sediment controls improperly installed
- ❑ Erosion and sediment control devices improperly maintained
- ❑ Fueling/washout/chemical storage areas not properly protected
- ❑ Portocan or other sanitary facilities not properly protected or leaking
- ❑ Self-inspection and maintenance records incomplete
- ❑ Sediment from site outside area of construction
- ❑ Other (see description below)

_____

_____

_____

The deficiencies must be corrected:
❑ immediately; ❑ within 48 hours;
❑ prior to re-inspection

Should the noted deficiencies not be corrected in the time frame indicated, further enforcement remedies will be sought.

For questions concerning the above:
Please contact the Storm Water Quality Group at
1002 Washington Avenue, 2nd Floor, Houston TX 77002
832-394-9108

Inspector's Name	Operator's Signature
Inspector's Cell Phone	Operator's Name ❑ not present

Distribution: white – Stormwater Quality Engineer gold – operator

PW&E 554

ATTACHMENT 6

TCEQ Office Use Only
Permit No:
CN:
RN:
Region:

Notice of Termination (NOT) for Authorizations under TPDES General Permit TXR150000

IMPORTANT INFORMATION:

Please read and use the General Information and Instructions prior to filling out each question in the form.

Effective September 1, 2018, this paper form must be submitted to TCEQ with a completed electronic reporting waiver form (TCEQ-20754).

ePermits: This form is available on our online permitting system.
Sign up for online permitting at: https://www3.tceq.texas.gov/steers/

What is the permit number to be terminated?

TXR15 _____ **TXRCW** _____

Section 1. OPERATOR (Permittee)

a) What is the Customer Number (CN) issued to this entity?
CN _____

b) What is the Legal Name of the current permittee?
_____

c) Provide the contact information for the Operator (Responsible Authority).
Prefix (Mr. Ms. or Miss): _____
First and Last Name: _____ Suffix: _____
Title: _____ Credentials: _____
Phone Number: _____ Fax Number: _____
Email: _____
Mailing Address: _____
City, State, and Zip Code: _____
Country Mailing Information, if outside USA: _____

Section 2. APPLICATION CONTACT

This is the person TCEQ will contact if additional information is needed regarding this application.

Is the application contact the same as the permittee identified above?

☐ Yes, go to Section 3.

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Notice of Termination for TXR150000

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☐ No, complete section below

Prefix (Mr. Ms. or Miss):

First and Last Name: Suffix:

Title: Credentials:

Phone Number: Fax Number:

Email:

Mailing Address:

City, State, and Zip Code:

Country Mailing Information, if outside USA:

Section 3. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

a) TCEQ issued RE Reference Number(RN): RN

b) Name of project or site as known by the local community:

c) County, or counties if more than 1:

d) Latitude: Longitude:

e) Site Address/Location:

If the site has a physical address such as 12100 Park 35 Circle, Austin, TX 78753, complete Section 3A.

If the site does not have a physical address, provide a location description in Section 3B. Example: located on the north side of FM 123, 2 miles west of the intersection of FM 123 and Highway 1.

Section 3A: Physical Address of Project or Site:

Street Number and Name:

City, State, and Zip Code:

Section 3B: Site Location Description:

Location description:

City where the site is located or, if not in a city, what is the nearest city:

Zip Code where the site is located:

Section 4. REASON FOR TERMINATION

Check the reason for termination:

☐ Final stabilization has been achieved on all portions of the site that are the responsibility of the Operator and all silt fences and other temporary erosion controls have been removed, or scheduled for removal as defined in the SWP3.

- ☐ Another permitted Operator has assumed control over all areas of the site that have not been finally stabilized, and temporary erosion controls that have been identified in the SWP3 have been transferred to the new Operator.
- ☐ The discharge is now authorized under an alternate TPDES permit.
- ☐ The activity never began at this site that is regulated under the general permit.

Section 5. CERTIFICATION

Signatory Name:

Signatory Title:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under 30 Texas Administrative Code §305.44 to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature (use blue ink):_____Date: _____

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Notice of Termination for TXR150000

Instructions for Notice of Termination (NOT) for Authorizations under TPDES General Permit TXR150000

GENERAL INFORMATION

Where to Send the Notice of Termination (NOT):

BY REGULAR U.S. MAIL:
Texas Commission on Environmental Quality
Stormwater Processing Center (MC-228)
P.O. Box 13087
Austin, Texas 78711-3087

BY OVERNIGHT/EXPRESS MAIL:
Texas Commission on Environmental Quality
Stormwater Processing Center (MC-228)
12100 Park 35 Circle
Austin, TX 78753

TCEQ Contact List:

Application status and form questions:	512-239-3700, swpermit@tceq.texas.gov
Technical questions:	512-239-4671, swgp@tceq.texas.gov
Environmental Law Division:	512-239-0600
Records Management - obtain copies of forms:	512-239-0900
Reports from databases (as available):	512-239-DATA (3282)
Cashier's office:	512 239-0357 or 512-239-0187

Notice of Termination Process:

A Notice of Termination is **effective on the date postmarked for delivery to TCEQ.**

When your NOT is received by the program, the form will be processed as follows:

1) Administrative Review: The form will be reviewed to confirm the following:
   - the permit number is provided;
   - the permit is active and has been approved;
   - the entity terminating the permit is the current permittee;
   - the site information matches the original permit record; and
   - the form has the required original signature with title and date.

2) Notice of Deficiency: If an item is incomplete or not verifiable as indicated above, a phone call will be made to the applicant to clear the deficiency. A letter will not be sent to the permittee if unable to process the form.

3) Confirmation of Termination: A Notice of Termination Confirmation letter will be mailed to the operator.

Change in Operator:

An authorization under the general permit is not transferable. If the operator of the regulated entity changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted not later than 10 days prior to the change in Operator status.

INSTRUCTIONS FOR FILLING OUT THE FORM

The majority of permit information related to the current operator and regulated entity are available at the following website: http://www2.tceq.texas.gov/wq_dpa/index.cfm.

Section 1. Operator (Current Permittee):

a) Customer Number (CN)
TCEQ's Central Registry assigns each customer a number that begins with CN, followed by nine digits. This is not a permit number, registration number, or license number. The Customer Number, for the current permittee, is available at the following website: http://www2.tceq.texas.gov/wq_dpa/index.cfm.

b) Legal Name of Operator
The operator must be the same entity as previously submitted on the original Notice of Intent for the permit number provided. The current operator name, as provided on the current authorization, is available at the following website: http://www2.tceq.texas.gov/wq_dpa/index.cfm.

c) Contact Information for the Operator (Responsible Authority)
Provide information for person signing the NOT application in the Certification section. This person is also referred to as the Responsible Authority.

Provide a complete mailing address for receiving mail from the TCEQ. Update the address if different than previously submitted for the Notice of Intent or Notice of Change. The mailing address must be recognized by the US Postal Service. You may verify the address on the following website: https://tools.usps.com/go/ZipLookupAction!input.action.

The phone number should provide contact to the operator.

The fax number and e-mail address are optional and should correspond to the operator.

Section 2. Application Contact:

Provide the name, title and contact information of the person that TCEQ can contact for additional information regarding this application.

Section 3. Regulated Entity (RE) Information on Project or Site:

a) Regulated Entity Reference Number (RN)
A number issued by TCEQ's Central Registry to sites where an activity regulated by TCEQ. This is not a permit number, registration number, or license number. The Regulated Entity Reference Number is available at the following website: http://www2.tceq.texas.gov/wq_dpa/index.cfm.

b) Name of the Project or Site
Provide the name of the site as known by the public in the area where the site is located.

c) County
Identify the county or counties in which the regulated entity is located.

d) Latitude and Longitude
Enter the latitude and longitude of the site in degrees, minutes, and seconds or decimal form. The latitude and longitude as provided on the current authorization is available at the following website: http://www2.tceq.texas.gov/wq_dpa/index.cfm.

e) Site/Project (RE) Physical Address/Location Information
The physical address/location information, as provided on the current authorization, is available at the following website: http://www2.tceq.texas.gov/wq_dpa/index.cfm.

Section 3A. If a site has an address that includes a street number and street name, enter the complete address for the site. If the physical address is not recognized as a USPS delivery address, you may need to validate the address with your local police (911 service) or through an online map site used to locate the site. Please confirm this to be a complete and valid address. Do not use a rural route or post office box for a site location.

Section 3B. If a site does not have an address that includes a street number and street name, provide a complete written location description. For example: "The site is located on the north side of FM 123, 2 miles west of the intersection of FM 123 and Highway 1."

Provide the city (or nearest city) and Zip Code of the facility location.

Section 4. Reason for Termination:

The Notice of Termination form is only for use to terminate the authorization (permit). The Permittee must indicate the specific reason for terminating by checking one of the options. If the reason is not listed then provide an attachment that explains the reason for termination.

Please read your general permit carefully to determine when to terminate your permit. Permits will not be reactivated after submitting a termination form. The termination is effective on the date postmarked for delivery to TCEQ.

Section 5. Certification:

The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code §305.44.

IF YOU ARE A CORPORATION:
The regulation that controls who may sign an application form is 30 Texas Administrative Code §305.44(a), which is provided below. According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:
The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a), which is provided below. According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statutes under which your government entity was formed. An NOI or similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to §305.44(a) (3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the Texas Commission on Environmental Quality's Environmental Law Division at 512-239-0600.

30 Texas Administrative Code §305.44. Signatories to Applications

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 01 31 47
Houston Permits

PART 1 - GENERAL

1.01 SUMMARY

A. Contractor will comply with requirements and provide coordination related to the City of Houston and Harris County permits.
B. Contractor will pay fees to pull and coordinate the permits.

1.02 CITY OF HOUSTON BUILDING PERMIT

A. Project# 23013453
B. First submittal: February 10, 2023
C. Anticipated approval: June 2024

1.03 CITY OF HOUSTON SITE WORK PERMIT

A. Project# 22100962
B. Expires: October 28, 2024
C. Includes: Site Civil, Sidewalk Permit, Paving, Utilities

1.04 HARRIS COUNTY FLOOD CONTROL DISTRICT

A. Project# 2210140097
B. Expires: June 7, 2025
C. Includes: Drainage Permit

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 01 32 13
Construction Schedules

PART 1 - GENERAL

A. Provide Construction Schedules for the Work included in this Contract in accordance with requirements in this Section. Create Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) plan. Provide printed activity listings and bar charts in formats described in this Section.

B. Combine activity listings and bar charts with narrative report to form Construction Schedule submittal for Project Manager.

1.02 SCHEDULING STAFF

A. Employ or retain services of individual experienced in CPM scheduling for duration of the Contract. Individual shall cooperate with Project Manager and update schedule monthly as required to indicate current status of the Work.

1.03 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. During preconstruction meeting, as described in Section 01 31 19 - Coordination and Meetings, provide sample bar charts and activity listings produced from scheduling software proposed. Scheduling software is subject to review by Project Manager and must meet requirements provided in this Section. Project Manager will provide review of samples within seven days of submittal.

C. Within 21 days of receipt of approval of Contractor's format, or 30 days of Notice to Proceed, whichever is later, submit proposed Construction Schedule for review. Base Construction Schedule submittal on the following:

1. Level of detail and number of activities required in schedule are dependent on project type.
2. For wastewater projects, categorize work type and area code in schedule.
3. For wastewater rehabilitation projects, there are six work- type categories. An area code will be assigned for each Meter Service Area or Basin. Include at least one activity for each unique combination of work type and area code. Normal schedules of wastewater rehabilitation projects contain between 35 and 100 activities, depending on number of basins and work types involved in each basin.
4. For wastewater relief projects (line work), area codes will be assigned geographically.
5. For wastewater plant or facility work, other criteria may apply to assignment of area codes, such as a combination of geographical and craft categories.
6. For projects with multiple types of tasks within scope, indicate types of work separately within schedule.

7. For projects with work at different physical locations or service areas, or different facilities within a site, indicate each location or facility separately within schedule. Show work on each floor of multi-story building as separate tasks.
8. For projects with multiple crafts or significant Subcontractor components, indicate elements separately within schedule. Unless permitted by Project Manager, tasks shall consist of work covered by only one division of Project Manual.
9. Unless permitted by Project Manager, each scheduled task shall be same as Schedule of Values line item, and vice versa.
10. For projects with Major Unit Price Work, indicate Shop Drawing submittal and review, purchase, delivery, and Installation dates on Project schedule. Include activities for testing, adjustment, and delivering O&M manuals.
11. No task except the acquisition of Major Unit Price Work shall represent more than one percent of Original Contract Price for facility projects and three percent of Original Contract Price for other projects. Duration of tasks may not exceed 40 calendar days.
12. For projects where operating facilities are involved, identify each period of work that will impact any process or operation in the schedule and that must be agreed to by Project Manager and facility operator prior to starting work in the area.

D. Construction Schedule submittals shall include:

1. printed bar charts that meet criteria outlined in this Section and are produced by Contractor's approved scheduling software;
2. activity listings that meet criteria outlined in this Section and are produced by Contractor's approved scheduling software; and
3. a predecessor/successor listing sorted by Activity ID that meets criteria outlined in this Section and is produced by Contractor's scheduling software.
4. A logic network diagram is required with the first Construction Schedule submittal for facilities projects.
5. Prepare and submit graphic or tabular display of estimated monthly billings (i.e. a cash flow curve for the Work) with the first schedule submittal. This information is not required in monthly updates, unless significant changes in work require re- submittal of schedule for review. Display shall allocate units indicated in bid schedule or Schedule of Values to Construction Schedule activities. Weighted allocations are acceptable, where appropriate. Dollar value associated with each allocated unit will be spread across the duration of that activity on a monthly basis. Total for each month and cumulative total will be indicated. These monthly forecasts are only for Project Manager’s planning purposes. Monthly payments for actual work completed will be made in accordance with the General Conditions.
6. Narrative Report that provides the information outlined in this Section.

E. No payment will be made until Project Manager approves Construction Schedule and billing forecast.

F. If Contractor desires to make changes in its method of operating and scheduling, after Project Manager has reviewed original schedule, notify Project Manager in writing, stating reasons for changes. When Project Manager considers these changes to be significant, Contractor may be required to revise and resubmit for review all or affected portion of Contractor's Construction Schedule to show effect on the Work.

G. Upon written request from Project Manager, revise and submit for review all or any part of Construction Schedule submittal to reflect changed conditions in the Work or deviations made from original schedule.

H. Updated Construction Schedule with actual start and actual finish dates, percent complete, and remaining duration of each activity shall be submitted monthly. Data date used in updating monthly Construction Schedule shall be the same date as used in monthly Payment Application. Monthly update of Construction Schedule is required for monthly Payment Application to be processed for payment.

1.04 SCHEDULING COMPUTER SOFTWARE REQUIREMENTS

A. Contractor's scheduling software shall be capable of creating bar charts and activity listings, which can be sorted by various fields (i.e. Activity ID, Early Start, Total Float, Area Code, Specification Section number, and Subcontractor). Use software capable of producing logic network diagram.

B. Use scheduling software capable of producing activity listings and bar charts with the following information for each activity in the schedule:

1. Activity ID
2. Activity Description
3. Estimated (Original) Duration
4. Remaining Duration
5. Actual Duration
6. Early Start Date
7. Late Start Date
8. Early Finish Date
9. Late Finish Date
10. Free Float
11. Total Float
12. Activity Codes (such as Area Code, Work Type, Specification Section, Subcontractor)

C. Use scheduling software capable of printing calendars using mathematical analysis of schedule, indicating standard workdays of week and scheduled holidays.

D. Use scheduling software capable of printing activity listing that indicates predecessors and successors, lag factors and lag relationships used in creating logic of the schedule.

E. Use scheduling software to provide monthly time in Bar Chart format and scale with 12- month scale not to exceed one page width. Bar charts may be printed or plotted on 8-1/2 by 11-inch, 8-1/2 by 14-inch or 11 by 17-inch sheet sizes. Over-size plots are not acceptable.

1.05 NARRATIVE SCHEDULE REPORT

A. Narrative schedule report shall list activities started this month, activities completed this month, activities continued this month, activities scheduled to start or complete next month, problems encountered this month, and actions taken to solve these problems.

B. Narrative schedule report shall describe changes made to Construction Schedule logic (i.e. changes in predecessors and lags), activities added to schedule, activities deleted from schedule, any other changes made to the schedule other than addition of actual start dates and actual finish dates and changes of data date and remaining durations for re- calculation of mathematical analysis.

1.06 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 32 23
Construction Surveying

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for construction surveying, construction staking and the coordination of the control with the Engineer.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related item listed on the Unit Price Schedule.
B. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.

1.03 STANDARDS

A. Utilize recognized survey practices as published by the Texas Board of Professional Land Surveying at http://txls.texas.gov/act-rules/.

1.04 CONTROL

A. Horizontal and vertical control and right-of-way monuments, as shown on the Plans, are provided.
B. Preserve control and right-of-way points. Where control points are in areas of construction, offsets or set supplemental control points will be established by the Contractor at no cost to the Owner. Notify the Engineer prior to performing work that will disturb project control.
C. Provide construction surveying and construction staking necessary to establish the line and grade of the proposed work from the control points, including labeled station markers every 100 feet.

1.05 ACCEPTANCE OF CONTROL

A. Notify the Engineer of any discrepancies discovered in the locations of survey control points prior to starting work.

1.06 DAMAGED MONUMENTS

A. Re-establish property corners and right-of-way monuments damaged or destroyed by the Contractor at no cost to the Owner. Perform the survey work to the TSPS Manual of Practice for Land Surveying in Texas. All survey work shall adhere to the current Act and Rules of the Texas Board of Professional Land Surveying.
B. Report promptly to the Engineer the loss or destruction of any reference points or boundary monuments.
C. Reimburse the Owner for the cost to reestablish permanent reference points disturbed by Contractor's operations.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 33 20
Construction Tests and Inspections

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for tests and inspection.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.
B. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.

1.03 ACCESS TO WORK

A. Provide access to Engineers and other representatives and personnel of the Owner, independent testing laboratories and governmental agencies with jurisdictional interests shall have access to the work for their observation, inspection and testing. Provide proper and safe conditions for such access and advice of site safety procedures and programs.
B. Provide Engineer 24 hour notice of readiness of the work for inspections, tests or approvals and cooperate with inspectors and testing personnel to facilitate required inspections or testing. Failure to provide 24 hour notice may result in the Work being removed and replaced at no cost to the Owner.

1.04 TESTS AND INSPECTIONS

A. Testing and Inspection includes, but is not limited to, services of a construction materials engineering laboratory or other agent employed by the Owner, to perform laboratory testing, field testing or examinations required in the Contract Documents.
B. The Owner will employ and pay for testing as noted above. Exceptions include, but are not limited to, the following:

    1. Arrange, obtain and pay for inspections, tests and approvals required by laws and regulations of other public bodies having jurisdiction.
    2. Transmit to the Engineer the required certificates of inspection or approval.
    3. Arrange, obtain and pay for inspections, tests or approvals required for submittals of materials or equipment. This includes expenses surrounding materials, mix designs or equipment submitted for approval for incorporation in the work.
    4. Perform retest or inspection of the corrected defective work at no cost to the Owner.
    5. Retests that are required to verify the adequacy of reworked areas or work for that work item.

C. Inspections and tests performed for either Engineer or Contractor shall be performed by an independent testing laboratory that is American Association for Laboratory Accreditation (A2LA) certified for the Work associated with the required inspections and tests.

D. Acceptance of tests or non-performance of tests or inspections, in no way relieves the Contractor of obligation to furnish required work in accordance with the Plans and Specifications.
E. Contractor may be required to remove and replace Work that is in non- conformance to inspections or tests at the discretion of the Engineer.
F. Removal and replacement of non-conforming Work shall be done at the Contractors expense.
G. Any inspection or test requested by the Contractor in addition to the standard minimum requirements shall be expense.

1.05 SUBMITTALS

A. Submit testing laboratory or examination reports, as specified or required, dated, signed and sealed by a Licensed Professional Engineer in the State of Texas accepting technical responsibility for the report. The work performed by the laboratory shall be covered by a report that accurately, clearly and unambiguously presents the test or examination results and other relevant information in accordance with the criteria for accreditation used by A2LA.

1.06 LIMITS OF AUTHORITY

A. The testing laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of the Contract Documents.
2. Approve or reject any portion of the work.
3. Perform any duties of the Contractor.
4. Stop the work.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 33 23
SHOP DRAWING, PRODUCT DATA, AND SAMPLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF REQUIREMENTS:

A. General: This section specifies procedural requirements for non-administrative submittals including shop drawings, product data, samples and other miscellaneous work-related submittals. Shop drawings, product data, samples and other work-related submittals are required to amplify, expand and coordinate the information contained in the Contract Documents.

1. Refer to other Division 1 sections and other contract documents for specifications on administrative, non-work-related submittals. Such submittals include, but are not limited to the following items:

a. Permits.
b. Payment applications.
c. Performance and payment bonds.
d. Insurance certificates.
e. Inspection and test reports.
f. Schedule of values.
g. Trench safety plans.
h. Barricade plans
i. Progress reports.
j. Listing of subcontractors.

B. Shop Drawings: Shop drawings prepared for this project by the Contractor including but not limited to the following items:

1. Fabrication and installation drawings.
2. Setting diagrams.
3. Shopwork manufacturing instructions.
4. Templates.
5. Patterns.
6. Coordination drawings (for use on-site).
7. Schedules.
8. Design mix formulas.
9. Contractor's engineering calculations.

Standard information prepared without specific reference to a project is not considered to be shop drawings.

After the contract is awarded, Kimley-Horn will provide instructions for uploading shop drawings electronically. The shop drawings shall be uploaded as pdfs with the correct shop drawing number followed by the shop drawing title as the file name.

C. Product data includes standard printed information on manufactured products that has not been specially-prepared for this project by the Contractor, including but not limited to the following items:

1. Manufacturer's product specifications and installation instructions.
2. Standard color charts.
3. Catalog cuts.
4. Roughing-in diagram and templates.
5. Standard wiring diagrams.
6. Printed performance curves.
7. Operational range diagrams.
8. Mill reports.
9. Standard product operating and maintenance manuals.

D. Samples: Samples to be provided for this project including but not limited to the following items:

1. Partial sections of manufactured or fabricated work.
2. Small cuts or containers of materials.
3. Complete units of repetitively-used materials.
4. Swatches showing color, texture and pattern.
5. Color range sets.
6. Units of work to be used for independent inspection and testing.

E. Miscellaneous submittals are work-related, non-administrative submittals that do not fit in the three previous categories, including, but not limited to the following:

1. Specially prepared and standard printed warranties.
2. Maintenance agreements.
3. Workmanship bonds.
4. Survey data and reports.
5. Project photographs.
6. Testing and certification reports.
7. Record drawings.
8. Field measurement data.
9. Operating and maintenance manuals.
10. Keys and other security protection devices.
11. Maintenance tools and spare parts.
12. Overrun stock.

1.03 SUBMITTAL PROCEDURES:

A. Coordination: Coordinate the preparation and processing of submittals with the performance of the work. Coordinate each separate submittal with other submittals and related activities such as testing, purchasing, fabrication, delivery and similar activities that require sequential activity.

1. Coordinate the submittal of different units of interrelated work so that one submittal will not be delayed by the Engineer's need to review a related submittal. The Engineer reserves the right to withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

B. Coordination of Submittal Times: Prepare and transmit each submittal to the Engineer sufficiently in advance of the Scheduled performance of related work and other applicable activities. Transmit different kinds of submittals for the same unit of work so that processing will not be delayed by the Engineer's need to review submittals concurrently for coordination.

C. Review Time: Allow sufficient time so that the installation will not be delayed as a result of the time required to properly process submittals, including time for resubmittal, if necessary. **Contractor shall allow for a ten calendar day review time from the date that the submittals arrive at the office of the Owner's representative.** Advise the Engineer on each submittal, as to whether processing time is critical to the progress of the work and if the work would be expedited if processing time could be shortened.

D. Submittal Preparation: Mark each submittal with a permanent label for identification. Provide a unique identification number (example "S001" for submittal 1) on the label for proper processing and recording of action taken.

E. Submittal Requirements: The number of copies of each submittal to be sent by the Contractor and the number of copies of each submittal to be returned is **one electronic copy or six hard copies of each submittal.**

F. **File names: Electronic files sent by email shall be named as follows:**

1. Submittal date (year, two-digit month, two-digit day), for example 20240604 for June 4, 2024, followed by a space.
2. Unique Submittal number, for example S001, followed by a space.
3. Version of this submittal, for example V01, for the first version, followed by a space.
4. Short name of the contents.
5. For example, "20240604 S001 V02 Blowers.PDF" or "20240604 S001 V02 Blowers.ZIP" for multiple files.

G. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Engineer, and to other destinations as

indicated, by use of a transmittal form. Submittals received from sources other than the Contractor will not be returned to the sender and no action will be taken by the Engineer.

1. Transmittal Form: Transmit all submittals with a properly completed Submittal Transmittal form.

    a. A separate transmittal form shall be used for each specific product, class of material, and equipment system.

    b. Items specified in different sections of the specifications are to be submitted separately unless integrally related.

2. Each transmittal form will record the following information for each submittal:
    a. Project name.
    b. Date.
    c. Name and address of Engineer.
    d. Name and address of Contractor.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Number and title of appropriate specification section.
    i. Drawing number and detail references, as appropriate.
    j. Contractor's review and approval markings,
    k. Statement of compliance with project specifications signed by Contractor or notice of deviations from project specifications signed by Contractor.
    l. Space for the Engineer's "Action" stamp.

1.04 SPECIFIC SUBMITTAL REQUIREMENTS:

A. General: Specific submittal requirements for individual units of work are specified in the applicable specification section. Except as otherwise indicated in the individual specification sections, comply with the requirements specified herein for each type of submittal.

Where it is necessary to provide intermediate submittals between the initial and final submittals, provide and process intermediate submittals in the same manner as for initial submittals.

B. Shop Drawings: Information required on shop drawings includes dimensions, identification of specific products and materials which are included in the work compliance with specified standards and notations of coordination requirements with other work. Provide special notation of dimensions that have been established by field measurement. Highlight, encircle or otherwise indicate deviations from the contract documents on the shop drawings.

1. Coordination Drawings: Provide coordination drawings where required for the integration of the work, including work first shown in detail on shop drawings or product data. Show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination drawings are considered shop drawings and must be definitive in nature.

2. Do not permit shop drawing copies without an appropriate final "Action" marking by the Engineer to be used in connection with the work.

3. Submit one (1) electronic copy or six (6) hard copies of shop drawings, layouts, manufacturer's data and material schedules as may be required by the Engineer for his review. Submittals shall be checked by and stamped with the approval of the Contractor and identified as the Engineer may require. Such review by the Engineer shall include checking for general conformance with the design concept of the project and general compliance with information given in the General Contract Documents. Indicated actions by the Engineer which may result from his review, shall not constitute concurrence with any deviation from the plans and specifications unless such deviations are specifically identified by the method described below, and further shall not relieve the Contractor of responsibility for errors or omissions in the submitted data. Processed shop drawing submittals are not change orders. The purpose of submittals by the Contractor is to demonstrate that the Contractor understands the design concept, and that he demonstrates his understanding by indicating which equipment and materials he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use. If deviations, discrepancies or conflicts between submittals and the design drawings and/or specifications are discovered, either prior to or after submittals are processed, the design drawings and specifications shall govern.

C. Product Data: General information required specifically as product data includes manufacturer's standard printed recommendations for application and use, compliance with recognized standards of trade associations and testing agencies, and the application of their labels and seals (if any), special notation of dimensions which have been verified by way of field measurement, and special coordination requirements for interfacing the material, product or system with other work.

1. Preparation: Collect required product data into a single submittal for each unit of work or system. Mark each copy to show which choices and options are applicable to the project. Where product data has been printed to include information on several similar products, some of which are not required for use on the project, or are not included in this submittal, mark the copies to show clearly that such information is not applicable.

    a. Where product data must be specially prepared for required products, materials or systems, because standard printed data is not suitable for use, submit data as "shop drawings" and not as "product data".

2. Submittals: Product data submittal is required for information and record and to determine that the products, materials and systems comply with the provisions of the contract documents. Therefore, the initial submittal is also the final submittal, except where the Engineer observes that there is non-compliance with the provisions of the contract documents and returns the submittal promptly to the Contractor marked with the appropriate "Action".

Provide a preliminary single-copy submittal where required, for selection of options by the Engineer.

a. The Engineer will retain one copy, and will return the other marked with "Action" and corrections or modifications as required.

b. Do not submit product data or allow its use on the project, until compliance with the requirements of the contract documents has been confirmed by the Contractor.

3. Installation Copy: Do not proceed with installation of materials, products and systems until a copy of product data applicable to the installation is in the possession of the installer. Do not permit the use of unmarked copies of product data in connection with the performance of the work.

D. Samples: Submit samples for the Engineer's visual review of general generic kind, color, pattern, and texture, and for a final check of the coordination of these characteristics with other related elements of the work. Samples are also submitted for quality control comparison of these characteristics between the final sample submittal and the actual work as it is delivered and installed.

1. Refer to individual work sections of these specifications for additional sample requirements, which may be intended for examination or testing of additional characteristics. Compliance with other required characteristics is the exclusive responsibility of the Contractor; such compliance is not considered in the Engineer's review and "Action" indication on sample submittals.

2. Documentation required specifically for sample submittals includes a generic description of the sample, the sample source or the product name or manufacturer, compliance with governing regulations and recognized standards. In addition, indicate limitations in terms of availability, sizes, delivery time, and similar limiting characteristics.

3. Refer to Division-26, Division-40, and Division-46 sections for additional general requirements applicable to samples for mechanical and electrical work, respectively.

4. Preparation: Where possible provide samples that are physically identical with the proposed material or product to be incorporated in the work; provide full scale, fully fabricated samples cured and finished in the manner specified. Where variations in color, pattern, or texture are inherent in the material or product represented by the sample, submit multiple units of the sample (not less than 3 units), which show the approximate limits of variations. Where samples are specified for the Engineer's selection of color, texture or pattern, submit a full set of available choices for the material or product. Mount, display, or package samples in the manner specified to facilitate the review of indicated qualities. Prepare samples to match the Engineer's sample where so indicated.

5. Submittal: At the Contractor's option, and depending upon the nature of the anticipated response from the Engineer, the initial submittal of samples may be either a preliminary submittal or a final submittal.

a. Preliminary Submittal: Submit 3 set of samples where requirements indicate the Engineer's selection of color, pattern, texture or similar characteristics from a manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with the Engineer's "Action" marking.

b. Final Submittals: Submit 3 sets of samples in the final submittal, one set will be returned.

c. Distribution of Samples: Maintain the final submittal sets of samples, as returned by the Engineer, at the project site, available for quality control comparisons throughout the course of performing the work. In addition, final submittal sets may be used to obtain final acceptance of the work associated with each set.

E. Miscellaneous Submittals:

1. Inspection and Test Reports: Classify each inspection and test report as being either "shop drawing" or "product data" depending on whether the report is specially prepared for the project, or a standard publication of workmanship control testing at the point of production. Process inspection and test reports accordingly.

2. Warranties: Refer to section "Products and Substitutions" for specific general requirements on warranties, product bonds, workmanship bonds and maintenance agreements. In addition to copies desired for the Contractor's use, furnish 2 executed copies of such warranties, bonds or agreements. Provide 2 additional copies where required for maintenance manuals.

3. Standards: Where submittal of a copy of standards is indicated, and except where copies of standards are specified as an integral part of a "Product Data" submittal, submit a single copy of standards for the Engineer's use. Where workmanship, whether at the project site or elsewhere is governed by a standard, furnish additional copies of the standard to fabricators, installers and others involved in the performance of the work.

4. Closeout Submittals: Refer to section "Project Closeout" and to individual sections of these specifications for specific submittal requirements of project closeout information, materials, tools, and similar items.

a. Record Documents: Furnish 1 set of record documents as maintained on the project site. Refer to Section 01 78 39 for a description of the Record Document requirements.

b. Operating and Maintenance Data: Furnish 4 bound copies of operating data and maintenance manuals.

c. Materials and Tools: Refer to individual sections of these specifications for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.

5. General Distribution: Provide additional distribution of submittals to governing authorities and others as necessary for the proper performance of the work. Include such additional copies of submittals in the transmittal to the Engineer where the submittals are required to receive "Action" marking before final distribution. Record distributions on transmittal forms.

1.05 ENGINEER'S ACTION:

A. General: Except for submittals for the record and similar purposes, where action and return on submittals is required or requested, the Engineer will review each submittal, mark with appropriate "Action", and return. Where the submittal must be held for coordination, the Engineer will so advise the Contractor.

1. Action Stamp: The Engineer will stamp each submittal to be returned with a uniform, self-explanatory action stamp, appropriately marked and executed to indicate whether the submittal returned is for no exceptions taken, exceptions noted, revise and submit, rejected, or files as received.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION.

SECTION 01 41 03

CONTRACTOR SAFETY PLAN

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section specifies administrative and procedural requirements for a Safety Plan that is to be prepared by the CONTRACTOR for this Project.

1.02 SAFETY PLAN

A. A Project Safety Plan/Manual is considered part of the Contract documentation. The requirements set forth in this section are to be considered the minimum safety requirements for this project. The CONTRACTOR's Safety Plan shall address these requirements and any other requirements set forth by OSHA 29 CFR 1926 AND 29 CFR 1910 that are applicable to the scope of work.

B. The CONTRACTOR shall submit a Site Safety Plan to the OWNER for review. On-site work shall not proceed until the Site Safety Plan is approved.

C. The site specific Safety Plan shall conform to all applicable State, Local and Federal safety regulations and requirements. The plan must at a minimum meet the following:

1. Contain the CONTRACTOR's name, address, submission date and reference to the specific job to which the site Safety Plan applies.
2. Contain a list of CONTRACTORS (Subs) and job contact personnel, including phone numbers in case of emergencies.
3. Include the name, qualification, background of duties and phone number of the CONTRACTOR's Safety Supervisor.
4. Definition of the safety responsibilities of the Supervisor, Foreman and work crew.
5. Comply with safety requirements contained herein and elsewhere in the contract.
6. Comply with the requirements set forth by OSHA, which at minimum shall include the following:
7. OSHA Subparts C,E,F,G,H,I,J,K,L,M,O,P,X CFR 1926 (as applicable)
8. 1926 Subpart C Housekeeping
   1926 Subpart E Personal Protective Equipment
   1926 Subpart F Fire Protection and Prevention
   1926 Subpart G Barricades
   1926 Subpart H Materials Handling
   1926 Subpart I Hand and Power tools
   1926 Subpart J Welding and Cutting
   1926 Subpart K Electrical Safety
   1926 Subpart L Scaffolds
   1926 Subpart M Fall Protection
   1926 Subpart O Vehicle Safety
   1926 Subpart P Trenching and Excavation

1926 Subpart X Ladder/Stairways
1926.52 Occupational Noise
1926.62 Lead
1926.101 Hearing Protection
1926.103 Respiratory Protection
1926.109 Record Keeping
1926.146 Confined Space

9. OSHA Subparts D,E,F,G,H,I,J,K,L,M,N,O,P,Q,S,Z CFR 1910 (as applicable)
   1910 Subpart D Walking/Working Surfaces
   1910 Subpart E Exit Routes EAP and Fire Prevention Plans
   1910 Subpart F Powered Platforms, Manlifts, and Vehicle Mounted Work Platforms
   1910 Subpart G Occupational Health and Environmental Control
   1910 Subpart H Hazardous Materials
   1910 Subpart I Personal Protective Equipment
   1910 Subpart J General Environmental Controls
   1910 Subpart K Medical and First Aid
   1910 Subpart L Fire Protection
   1910 Subpart M Compressed Gas and Compressed Air Equipment
   1910 Subpart N Materials Handling and Storage
   1910 Subpart O Machinery and Machine Guarding
   1910 Subpart P Hand and Portable Powered Tools and Other Hand Held Equipment
   1910 Subpart Q Welding, Cutting and Brazing
   1910 Subpart S Electrical
   1910 Subpart Z Toxic and Hazardous Substances
10. Provide content of the Safety Orientation and/or Hazardous Awareness training that the CONTRACTOR is giving to all workers at the project site. Define records to be kept to track and ensure all persons have completed the training (i.e. muster sheets, training records, stickers on the hardhat).
11. Provide a list of Hazardous Materials to be used on site and the corresponding (MSDS) Material Safety Data Sheets.
12. Include a description of the Personal Protective Equipment that is mandatory for use on the site.
13. Describe the Respiratory Protection Program. The description should include the selection of respirators, fit testing procedures, training in the use of equipment and function and familiarization with the signs and symptoms of exposure (symptomatic warnings).
14. Define the essential fall protection program protocols instituted on the project site.
15. Detail safety procedures for Confined Space entry, monitoring, permitting and extraction in emergency situations.
16. Describe procedures for barricades, fences, warning signs etc. to restrict unauthorized personnel from entering the site.

17. Include a plan to ensure adequate ventilation, sanitation and dust control are achieved.
18. Describe procedures for hot work/fire protection including, fire watches, shielding and placement of fire extinguishers.
19. Provide Lockout/Tagout or LOTO details and precautions to deal with potential live power and utility lines.
20. Provide detailed procedure for Lead Abatement to include the Lead Abatement Plan with proper procedures for personnel and area monitoring.
21. Describe procedures to comply with proper labeling of drums and containers per 29 CFR 1910.1200 the HAZCOM standard.

1.03 COORDINATION

A. The CONTRACTOR shall coordinate its Safety Plan to include all trades, subs, and any other persons working for him/her on the site. The CONTRACTOR shall ensure strict adherence by all subs with the Safety Plan

1.04 DISTRIBUTION

A. Distribute copies of the Safety Plan to the following:

1. OWNER
2. Subcontractors
3. Inspectors
4. Other concerned parties

PART 2 - PRODUCTS (NOT USED)
PART 3 - EXECUTION (NOT USED)

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 01 45 23
TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: Provide testing and inspecting, complete, as described in this Section and elsewhere in the Contract Documents.

B. Related Work:

1. Requirements for testing may be described in various Sections of these Specifications.

1.02 QUALITY ASSURANCE:

A. Provide the services of a soils engineer and a testing laboratory approved by the Engineer.

B. Upon completion of each test and/or inspection, promptly distribute copies of test or inspection reports to the Engineer, to governmental agencies requiring submission of such reports, and to such other persons as directed by the Engineer.

C. Employment of Testing Laboratory shall in no way relieve Contractor of his obligations to perform work in accordance with contract documents.

D. Qualifications of laboratory:

1. Meet ACIL requirements referenced.
2. Meet basic requirements of ASTM E 329.
3. Authorized to operate in State in which project is located.
4. Meet minimum requirements specified in other sections of the Contract Documents.

PART 2 - PRODUCTS

2.01 PAYMENT FOR TESTING:

A. Owner will provide quality assurance testing performed by a firm employed directly by the Owner. Testing firm will provide soil density and concrete sampling. Owner provided testing will not include specialty testing such as radiographic weld inspection, structural bolting, generator performance, and high voltage electrical systems. Contractor will provide specialty testing identified in the individual specifications.

B. The Contractor shall include within the Contract Sum an amount sufficient to cover all testing and inspecting required under this Section of these Specifications, and to cover all testing and inspecting required by governmental agencies having jurisdiction.

C. When initial tests requested by the Engineer indicate non-compliance with the Contract Documents, costs of initial tests associated with that non-compliance will be deducted by the Owner from the Contract Sum, and subsequent retesting occasioned by the non-compliance shall be performed by the same testing laboratory and the costs thereof shall be paid by the Contractor.

2.02 SPECIFIC TESTS AND INSPECTIONS:

A. Provide all tests and inspections required by governmental agencies having jurisdiction, required by provisions of the Contract Documents, and such other tests and inspections as are directed by the Engineer.

B. Tests include, but are not necessarily limited to, those described in detail in Part 3 of this Section.

2.03 CONTRACTOR'S RESPONSIBILITIES:

A. Cooperate with Laboratory personnel; provide access to Work, and to manufacturer's operations.

B. When materials require testing prior to being incorporated into Work, secure and deliver to Laboratory adequate quantities of representative samples of materials proposed to be used.

C. Furnish copies of product test reports as required.

D. Furnish incidental labor and facilities:

1. To provide access to work to be tested.
2. To obtain and handle samples at site or at source of product to be tested.
3. To facilitate inspections and tests.
4. For safe storage and cutting of test samples.

E. Notify Laboratory sufficiently in advance of operations to allow for Laboratory assignment of personnel and scheduling of tests.

F. Make arrangements with Laboratory and pay for additional samples and tests required for Contractor's convenience.

PART 3 - EXECUTION

3.01 TAKING SPECIMENS:

A. Except as may be specifically otherwise approved by the Engineer, have the laboratory secure and handle all samples and specimens for testing.

3.02 COOPERATION WITH TESTING LABORATORY:

A. Provide access to the Work at all times and at all locations where the Work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.

3.03 CONCRETE INSPECTING AND TESTING:

A. Portland Cement:

1. Secure from the cement manufacturer Certificates of Compliance delivered directly to the concrete producer for further delivery directly to the testing laboratory.

2. Require the Certificates of Compliance to positively identify the cement as to production lot, bin or silo number, dating and routing of shipment, and compliance with the specified standards.

3. If so required by the Engineer, promptly provide such other specific physical and chemical data as required.

B. Aggregate:

1. Provide one test unless character of material changes, material is substituted, or additional test is requested by the Engineer.

2. Sample from conveyor belts or batching gates at the ready-mix plant:

a. Sieve analysis to determine compliance with specified standards and grading;
b. Specific gravity test for compliance with specified standards.

C. Laboratory Design Mix:

1. After approval of aggregate, and whenever character or source of materials is changed, provide mix design in accordance with ACI 613.

2. Provide designs for all mixes prepared by a licensed civil engineer.

D. Molded Concrete Cylinders:

1. Provide four test cylinders for each 50 cu. yds or fraction thereof, of each class of concrete of each day's placement.

2. Test one cylinder at seven days, two at 28 days, and one when so directed.

3. Report the mix, slump, location of concrete in the structure, and test results prior to the addition of any plasticizers.

4. Take specimens and make tests in accordance with the applicable ASTM standard specifications.

E. Core Tests:

1. Provide only when specifically so directed by the Engineer because of low cylinder test results.

2. Cut from locations directed by the Engineer, securing in accordance with ASTM C42, and prepare and test in accordance with ASTM C39.

F. Placement Inspections:

1. On concrete over 2,000 psi, provide continuous or other inspection as required by governmental agencies having jurisdiction.

2. Throughout progress of concrete placement, make slump tests to verify conformance with specified slump.

3. Using all required personnel and equipment, throughout progress of concrete placement verify that finished concrete surfaces will have the level or slope that is required by the Contract Documents.

3.04 DENSITY:

1. Provide geotechnical observation and materials testing including: compacted moisture / density of all backfill soils at the rate of one test per 250 linear feet of trench, for each lift of fill placed, during compaction.

2. Digging through existing lifts of backfill to access and test underlying lifts is not allowed.

END OF SECTION

SECTION 01 52 00
CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: Provide temporary facilities and controls needed for the Work including, but not necessarily limited to:

1. Temporary utilities such as water, electricity, and telephone;
2. Sanitary facilities;
3. Enclosures such as tarpaulins, barricades, and canopies;
4. Temporary fencing of the construction site;
5. Security;
6. Water, erosion, sediment, and dust control;
7. Removal.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

2. Except that equipment furnished by subcontractors shall comply with requirements of pertinent safety regulations, such equipment normally furnished by the individual trades in execution of their own portions of the Work are not part of this Section.

3. Permanent installation and hookup of the various utility lines are described in other Sections.

1.02 PRODUCT HANDLING:

A. Maintain temporary facilities and controls in proper and safe condition throughout progress of the Work.

PART 2 - PRODUCTS

2.01 UTILITIES:

A. Water:

1. Provide necessary temporary piping and/or water supply and, upon completion of the Work, remove such temporary facilities.

2. Contractor shall be responsible for the transport and/or delivery of water to the project site. Contractor shall include within the Contract Sum an amount sufficient to cover all site water as subsidiary to other pay items, no separate payment will be allowed.

B. Electricity:

1. Provide necessary temporary wiring and, upon completion of the Work, remove such temporary facility.

2. Provide area distribution boxes so located that the individual trades may furnish and use 100 foot maximum length extension cords to obtain power and lighting at points where needed for work, inspection, and safety.

3. Provide and pay for electricity used in construction.

2.02 FIELD OFFICES AND SHEDS:

A. Contractor's facilities:

1. A field office is required for this project.

2.03 DEWATERING:

A. For the entire duration of the Contract, the Contractor, at his expense, shall keep all parts of the project, site, including excavations, free from any accumulation of water, regardless of the source or cause of such water, by adequate trenching and pumping as required.

B. Pumping shall include adequate pumps, hose strainers, and other appurtenances, fuel, power, trenching, and pumping as required.

C. Water shall be disposed of in such a manner as will not endanger public health or cause damage or expense to public or private property, and in accordance with the requirements of any public agencies having jurisdiction. If sewers and streets are used for drainage or the disposal of water during construction, they shall be maintained and left satisfactorily clean upon the completion of the work.

2.04 ENCLOSURES:

A. Provide and maintain for the duration of construction all scaffolds, tarpaulins, canopies, warning signs, steps, platforms, bridges, and other temporary construction necessary for proper completion of the Work in compliance with pertinent safety and other regulations.

2.05 TEMPORARY PROTECTION:

A. The Contractor or subcontractors shall also be responsible for protecting his work from damage due to the weather.

2.06 TEMPORARY FENCING:

A. Provide and maintain for the duration of construction a temporary fence of design and type needed to prevent entry onto the Work by the public.

2.07 PROJECT SIGNS:

A. Project signs are required for this project.

B. Except as otherwise specifically approved by the Engineer, do not permit other signs or advertising on the job site.

C. Provide two (2) project signs at field locations agreed upon by Owner's inspector.

PART 3 - EXECUTION

3.01 MAINTENANCE AND REMOVAL:

A. Maintain temporary facilities and controls as long as needed for safe and proper completion of the Work.

B. Remove such temporary facilities and controls as rapidly as progress of the Work will permit, or as directed by the Engineer.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 01 56 26
Construction Fence

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for furnishing, installing, maintaining and removing construction fence.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.
B. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.

PART 2 - PRODUCTS

2.01 FENCE PROPERTIES

A. Provide construction fence comprised of extruded, high-density polypropylene, 4 foot tall minimum and orange in color unless shown otherwise on the Plans.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the construction fence with posts of sufficient size and spacing to insure that the construction fence remains upright throughout its installed length and functions as an effective barrier for the areas designated for protection.
B. Maintain and repair the construction fence throughout the duration of the project, at no cost to the Owner, to insure that the barrier continuously performs its intended function.

3.02 REMOVAL AND DISPOSAL

A. Remove and dispose of the construction fence upon completion of the project. Refer to Section 02 41 13 - Material Disposal.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 01 57 00
General Source Controls

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for best management practices and care of the work area.

1.02 MEASUREMENT AND PAYMENT

A. Where there is not a separate item listed on the Unit Price Schedule for work in this Section, no separate measurement and payment is made. Include cost for work under this Section in the related item listed on the Unit Price Schedule.
B. Measurement and Payment is as noted on the Unit Price Schedule.
C. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.

1.03 DEFINITION

A. State Waters: The water of the ordinary flow, underflow, and tides of every flowing river, natural stream, and lake, and of every bay or arm of the Gulf of Mexico, and the stormwater, floodwater, and rainwater of every river, natural stream, and watercourse in the state. State Waters do not include percolating groundwater, diffuse surface rainfall runoff, groundwater seepage or springwater before it reaches the watercourse.

1.04 PROTECTION OF TREES

A. Heavy equipment, vehicular traffic and stockpiles of construction materials are not permitted within the dripline of any tree designated to remain. Contractor shall avoid all contact with trees to remain unless otherwise directed by the Engineer. For trees determined to have been damaged refer to Specification Section 32 92 01 - Tree and Plant Protection.
B. Trees to remain will be shown on the Plans or marked onsite prior to construction. For Additional information, refer to Specification Section 32 92 01 - Tree and Plant Protection.

1.05 DUST CONTROL

A. Control dust blowing and movement on construction sites and roads to prevent exposure of soil surfaces, to reduce on and offsite damage, to prevent health hazards and to improve traffic safety.
B. Control dust blowing by utilizing one or more of the following:

1. Paper or wood mulches bound with natural or chemical binders.
2. Temporary vegetative cover.
3. Apply dust suppressants containing polyacrylamide (PAM) at for duration required. Submit manufacturer's data.
4. Irrigation by water sprinkling.
5. Spreading hay.
6. Implement dust controls immediately whenever dust can be observed blowing on the site or as directed by the Engineer.

C. Provide copy of Water Rights Permit from the Texas Commission on Environmental Quality (TCEQ) prior to using State Water.

1.06 EQUIPMENT MAINTENANCE AND REPAIR

A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose. Locate and design designated areas so that oils, gasoline, grease, solvents and other potential pollutants cannot be allowed into soils, receiving streams or stormwater conveyance systems. Provide adequate waste disposal receptacles for liquid, as well as, solid waste. Inspect and clean maintenance areas daily.

B. On a site where designated equipment maintenance areas are not feasible, care must be taken during each individual repair or maintenance operation to prevent potential pollutants from becoming available to be washed into streams or stormwater conveyance systems. Provide and use temporary waste disposal receptacles.

1.07 WASTE COLLECTION AND DISPOSAL

A. Refer to Section 02 41 13 - Material Disposal.

B. Provide a plan for the collection and disposal of waste materials on the site, at the request of the Engineer. Designate locations for trash and waste receptacles and establish a collection schedule. Specify and carry out methods for ultimate disposal of waste in accordance with applicable local, State and Federal rules and regulations. Make special provisions for the collection and disposal of liquid wastes and toxic or hazardous materials.

C. Keep receptacles and other waste collection areas neat and orderly. Do not allow waste to overflow its container or accumulate for excessively long periods of time. Locate trash collection points where they will least likely be affected by stormwater runoff.

1.08 PUBLIC ROAD MAINTENANCE

A. Remove soil spilled, dropped, washed or tracked on to public rights-of-way immediately.

1.09 WASHING AREAS

A. Wash vehicles and other construction equipment in accordance with current local, State and Federal rules and regulations and, as a minimum, vehicles such as concrete or dump trucks and other construction equipment shall not be washed at locations where runoff will flow directly into a watercourse or stormwater conveyance system. Special areas shall be designated for washing vehicles. These areas should be located where the wash water will spread out and evaporate or infiltrate directly into the ground, or where runoff can be collected in a temporary holding or seepage basin. Construct wash areas with gravel or rock bases to minimize mud generation.

1.10 CONCRETE WASH OUT AREAS

A. Wash concrete trucks only in a designated concrete truck wash out area. Contain washed out materials in such a manner as to prevent discharges directly into the receiving water(s). Excavated traps, earthen embankment traps, or filter fabric fences may be used for containment. Stabilize designated areas prior to project completion to prevent material from

entering the receiving water. For projects including a formal Notice of Intent (NOI), refer to the SWPPP narrative for detailed information on concrete wash out activities.

1.11 STORAGE OF CONSTRUCTION MATERIALS, CHEMICALS, ETC.

A. Isolate sites where chemicals, cements, solvents, paints or other potential water pollutants are to be stored, so that they will not cause runoff pollution.
B. Store toxic chemicals, and materials such as fuels, lubricants, pesticides, paints, and acids in accordance with manufacturer's requirements.
C. groundwater resources from leaching by placing a plastic liner or other containment system, as approved by the Engineer, on any areas where toxic liquids are to be opened and stored.

1.12 SANITARY FACILITIES

A. Provide construction site with adequate sanitary facilities for workers in accordance with applicable local, State and Federal rules and regulations.

1.13 INSPECTION REPORTS

A. Maintained for sediment control. Submit Weekly Texas Pollutant Discharge Elimination System (TPDES) Inspection and Maintenance Reports on a monthly basis, or as required by the Engineer.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 NOT USED

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 01 57 23
CONTROL OF GROUND WATER AND SURFACE WATER

PART 1 GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Control of ground water and surface water.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.02 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for control of ground water or surface water for construction of precast or cast-in-place concrete structures, including concrete slabs, manholes, wet wells, etc. Include cost to control ground water and surface water in unit price for each concrete structure. If Contract is Stipulated Price Contract, payment for this Work is included in the total Stipulated Price.

B. Include cost for work under this Section in the related items in the Site Civil pay item.

1.03 REFERENCES:

A. ASTM D698 – Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3).

B. Federal Regulations29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

1.04 DEFINITIONS:

A. Ground water control includes both dewatering and depressurization of water-bearing soil layers.

1. Dewatering includes lowering water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts, and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization includes reduction in piezometric pressure within strata not controlled by dewatering alone, as required to prevent failure or heaving of excavation bottom or instability of tunnel excavations.
3. Excavation drainage includes keeping excavations free of surface and seepage water.
4. Surface drainage includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect work from any source of surface water.
5. Equipment and instrumentation for monitoring and control of ground water control system includes piezometers, monitoring wells and flow meters for observing and recording flow rates.
6. Surface water includes water from rainfall, runoff, the SJRA canal, and all other sources not considered ground water.

1.05 PERFORMANCE REQUIREMENTS:

A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems. Submit prepared method and spacing of readings for review prior to obtaining water level readings.

B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 31 41 00 – Trench Safety System to produce following results:

1. Effectively reduce hydrostatic pressure affecting:
   a) Excavations
   b) Tunnel excavation, face stability, or seepage into tunnels
2. Develop substantially dry and stable subgrade for subsequent construction operations
3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities, and other work
4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata
5. Maintain stability of sides and bottom of excavations

C. Provide ground water control systems that include single-stage or multiple-stage well point systems, educator and ejector-type systems, deep wells, or combinations of these equipment types, as appropriate.

D. Provide drainage of seepage water and surface water, as well as water from any other source entering excavation. Excavation drainage may include placement of

drainage materials, crushed stone, and filter fabric, together with ditches and sump pumping.

E. Provide ditches, berms, pumps, and other methods necessary to divert and drain surface water from excavation and other work areas.

F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.

H. Provide adequate number of piezometers installed at proper locations and depths as required to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.

I. Provide environmental monitoring wells installed at proper locations and depths as required to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

1.06 SUBMITTALS:

A. Conform to requirements of Section 01 33 00 – Submittals.

B. Submit Ground Water and Surface Water Control Plan for review by Owner's Representative prior to start of any field work. Plan shall be signed by Professional Engineer registered in State of Texas. Submit plan to include following:

1. Results of subsurface investigation and description of extent and characteristics of water bearing layers subject to ground water control
2. Names of equipment suppliers and installation subcontractors
3. Description of proposed ground water control systems indicating arrangement, location, depth, and capacities of system components, installation details and criteria and operation and maintenance procedures
4. Description of proposed monitoring and control system indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics
5. Description of proposed filters including types, sizes, capacities, and

manufacturer's application recommendations

6. Certification of design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.
7. Operating requirements, including piezometric control elevations for dewatering and depressurization

1.07 EXCAVATION DRAINAGE METHODS INCLUDING TYPICAL DRAINAGE LAYERS, SUMP PUMP APPLICATION AND OTHER NECESSARY MEANS:

1. Surface water control and drainage installations
2. Proposed methods and locations for disposing of removed water

C. Submit following records upon completed initial installation:

1. Installation and development reports for well points, eductors, and deep wells
2. Installation reports and baseline readings for piezometers and monitoring wells
3. Baseline analytical test data of water from monitoring wells
4. Initial flow rates

D. Submit the following records weekly during operations:

1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.2, Requirements for Eductor, Well Points, or Deep Wells.
2. Maintenance records for ground water control installations, piezometers and monitoring wells

1.08 ENVIRONMENTAL REQUIREMENTS:

A. Comply with requirements of agencies having jurisdiction.
B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.
C. Obtain necessary permits from agencies with control over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Because review and permitting process may be lengthy, take early action to pursue and submit for required approvals.
D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.
E. Filter water discharged from dewatering systems prior to entering drainage ways.

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIALS:

A. Use optional equipment and materials as necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review of Owner's Representative through submittals required in Paragraph 1.6, Submittals.
B. Eductors, well points, or deep wells, where used, must be furnished, installed and operated by experienced contractor regularly engaged in ground water control system design, installation, and operation.
C. Equipment must be in good repair and operating order.
D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.

PART 3 EXECUTION

3.01 GROUND WATER CONTROL:

A. Perform subsurface investigation by borings as necessary to identify water bearing layers, piezometric pressures, and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics of waterbearing layers. Present results in Ground Water and Surface Water Control Plan (See Paragraph 1.6B.1).
B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.
C. Install, operate, and maintain ground water control systems in accordance with Ground Water and Surface Water Control Plan. Notify Owner's Representative in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.
D. Provide for continuous system operation, including nights, weekends, and holidays. Arrange for appropriate backup if electrical power is primary energy source for dewatering system.
E. Monitor operations to verify system lowers ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for prosecution of subsequent operations.
F. Where hydrostatic pressures in confined water bearing layers exist below excavation, depressurize those zones to eliminate risk of uplift or other instability of

excavation or installed works. Define allowable piezometric elevations in Ground Water and Surface Water Control Plan.

G. Remove ground water control installations.

3. Remove pumping system components and piping when ground water control is no longer required

4. Remove monitoring wells when directed by Owner's Representative.

5. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonitenon-shrink grout or cement-sand grout along entire shaft length.

H. During backfilling, dewatering may be reduced to maintain water level minimum of 5 feet below prevailing level of backfill. However, do not allow that water level to result in uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement stabilized sand until at least 48 hours after placement.

I. Provide uniform diameter for each pipe drain run constructed for dewatering. Remove pipe drain when it has served its purpose. If removal of pipe is impractical, provide grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout when pipe is removed from service.

J. Extent of construction ground water control for structures with permanent perforated underground drainage system may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide means of draining affected portion of underground system, including standby equipment. Maintain drainage system during operations and remove it when no longer required.

K. Remove system upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.

M. Foundation Beds: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.

3.02 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS:

A. Design, install, and operate all dewatering wells to prevent the removal of native material except as incidental to well development.

B. For aboveground piping in ground water control system, include 12-inch minimum length of clear, transparent piping between every eductor well or well point and discharge header to visually monitor discharge from each installation.

C. Install sufficient piezometers or monitoring wells to show trench or shaft excavations in water bearing materials are predrained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of Work.
D. Install piezometers or monitoring wells not less than 1 week in advance of beginning associated excavation.
E. Dewatering may be omitted for portions of under drains or other excavations, but only where auger borings and piezometers or monitoring wells show that soil is predrained by existing system and that criteria of ground water control plan are satisfied.
F. Replace installations that produce noticeable amounts of sediments after development.
G. Provide additional ground water control installations, or change methods, in event that installations according to ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specification. Submit revised plan according to Paragraph 1.6B.

3.03 EXCAVATION DRAINAGE:

A. May use excavation drainage methods if necessary to achieve well drained conditions. Excavation drainage may consist of layer of crushed stone and filter fabric, and sump pumping in combination with sufficient wells for ground water control to maintain stable excavation and backfill conditions.

3.04 MAINTENANCE AND OBSERVATION:

A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage are operating in area or seepage into tunnel is occurring. Keep system in good condition.
B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedule.
C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make observations, as specified.
D. Remove and grout piezometers inside or outside excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Owner's Representative. Follow applicable regulations for abandoning piezometers and monitoring wells.

3.05 MONITORING AND RECORDING:

A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also monitor and record water level and ground water recovery. Obtain records daily until steady conditions are achieved, and twice weekly thereafter.
B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Owner's Representative determines more frequent monitoring and recording are required. Comply with Owner's Representative direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.

3.06 SURFACE WATER CONTROL:

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.
B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

END OF SECTION

SECTION 01 57 23
Storm Water Pollution Prevention Control

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Implementation of Storm Water Pollution Prevention Plans (SWP3) described in Section 01 31 46 - TPDES Requirement.
B. Installation, maintenance and removal, of storm water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders. Structures are used during construction and prior to final development of the site.
C. Filter Fabric Barriers:

1. Type 1: Temporary filter fabric barrier for erosion and sediment control in non-channelized flow areas.
2. Type 2: Temporary reinforced filter fabric barrier for erosion and sediment control in channelized flow areas.

D. Hay Bale Fence
E. Drop Inlet Basket
F. Inlet Sediment Traps
G. Brush Berm
H. Sand Bag Barrier
I. Bagged Gravel Barrier
J. Sediment Basin
K. Inlet Protection Barrier

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.
B. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.03 REFERENCE STANDARDS

A. ASTM A 36 - Standard Specification for Carbon Structural Steel.
B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)).
C. ASTM D3786 -Standard Test Method for Hydraulic Bursting Strength for knitted Goods and Nonwoven Fabrics.
D. ASTM D 4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
E. ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
F. ASTM 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
G. ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
H. ASTM D 6382 - Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.

I. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.04 SYSTEM DESCRIPTIONS

A. Filter Fabric Barrier Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Barriers to remain in proper position and configuration at all times.
B. Hay Bale Fence: Install to allow surface runoff percolation through hay in sheet-flow manner and to retain and accumulate sediment. Maintain Hay Bale Fence to remain in proper position and configuration at all times.
C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from project area into sediment traps.
D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.
E. Sediment Traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.
F. Sand Bags: Are used during construction activities in unstabilized minor swales, ditches, or streambeds when the contributing drainage area is no greater than 2 acres. It is also sediment barrier for stage one Inlet.
G. Bagged Gravel Barrier: Are used during construction activities in unstabilized minor swales, ditches, or streambeds when the contributing drainage area is no greater than 2 acres. It is also sediment barrier for stage two Inlet.
H. Drop Inlet Insert Basket: Is a temporary barrier placed within a storm drain inlet (Lower Portion of Stage I and Upper Portion of Stage II Inlets) consisting of a filter fabric supported by a metal frame work to prevent sediment and other pollutants from entering convey system.
I. Brush Berm: Brush Berm is constructed at the perimeter of a distribute site within the developing area.

1.05 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.
B. Submit manufacturer's literature for product specifications and installation instructions.
C. Submit manufacturer=s catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.
D. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.
E. Submit shop drawings for Drop Inlet Baskets.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Concrete: Class B in accordance with Section 03 30 53 - Concrete for Utility Construction or as shown on the Drawings.

2.02 AGREGATE MATERIALS

A. Use poorly graded cobbles with diameter greater than 3 inches and less than 5 inches.
B. Provide gravel lining in accordance with Section 2320 - Utility Backfill Materials or as shown on the drawings.

C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.
D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

2.03 PIPE

A. Polyethylene culvert pipe or PVC sewer pipe in accordance with Section 33 05 33- High Density Polyethylene (HDPE) Solid and Profile Wall Pipe and Section 33 05 33 Polyvinyl Chloride Pipe or as shown on the Drawings.
B. Inlet Pipes: Galvanized steel pipe in accordance with Section 33 05 27 Corrugated Metal Pipe or as shown on the Drawings.
C. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.

2.04 GEOTEXTILE FILTER FABRIC

A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.
B. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.
C. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees F.
D. Mirafi, Inc., Synthetic Industries, or equivalent

2.05 BARRIER

A. Wire Barrier: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.
B. Barrier Stakes: Nominal 2 by 2 inch moisture-resistant treated wood or steel posts (min. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140) with safety caps on top length as required for minimum 8 inch bury and full height of filter fabric.

2.06 SANDBAGS

A. Provide woven material made of polypropylene, polyethylene, or polyamide material.
    1. Minimum unit weight of four ounces per square yard.
    2. Minimum grab strength of 100 lbs in any principal direction (ASTM D4632)
    3. Mullen burst strength exceeding 300 lbs (ASTM D4833).
    4. Ultraviolet stability exceeding 70 percent. After 500 hours of exposure (ASTM 4355).
    5. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches.
B. Weight: Approximately 40 to 50 pounds not to exceed 75 pounds.

2.07 BAGGED GRAVEL BARRIER

1. Minimum unit weight of four ounces per square yard.
2. Minimum grab strength of 100 lbs in any principal direction (ASTM D4632)
3. Mullen burst strength exceeding 300 lbs (ASTM D4833).
4. Ultraviolet stability exceeding 70 percent. After 500 hours of exposure (ASTM 4355).
5. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches.

B. Weight: Approximately 40 to 50 pounds not to exceed 75 pounds.

2.08 DROP INLET BASKET

A. Provide steel frame members in accordance with ASTM A36.
B. Construct top frame of basket with two short sides of 2 inch by 2 inch and single long side of 1 inch by 1 inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1 inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket.
C. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame.
D. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

2.09 HAY BALE

A. Hay: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.
B. Hay Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18 inch bury and full height bales.

PART 3 - EXECUTION

3.01 PREPARATION, INSTALLATION AND MAINTEINANCE

A. Provide erosion and sediment control structures at locations shown on the Drawings.
B. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Project Manager to allow installation of erosion and sediment control systems, soil testing and surveying.
C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manager to remove and discard existing system.
D. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. . Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Project Manger. Dispose of materials in accordance with Section 01 57 23 - Waste Material Disposal.
E. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Section 01 57 23 - Waste Material Disposal.
F. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Section 31 23 33 Roadway Excavation or Section 2317 Excavation and Backfill for Utilities.
G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.
H. Protect existing trees and plants in accordance with Section 32 92 01 - Tree and Plant Protection.

3.02 SEDIMENT TRAPS

A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.
B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.
C. Use fill material for embankment in accordance with Section 31 23 23 - Utility Backfill Materials.
D. Excavation length and height shall be as specified on Drawings. Use side slopes of 2:1 or flatter.

3.03 STONE OUTLET SEDIMENT TRAPS:

A. Maintain minimum of 6 inches between top of core material and top of stone outlet, minimum of 4 inches between bottom of core material and existing ground and minimum of 1 foot between top of stone outlet and top of embankment.
B. Embed cobbles minimum of 4 inches into existing ground for stone outlet. Core shall be minimum of 1 foot in height and in width and wrapped in triple layer of geotextile filter fabric.
C. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.
D. Remove sediment deposits when design basin volume is reduced by one- third or sediment level is one foot below principal spillway crest, whichever is less.

3.04 FILTER FABRIC BARRIER CONSTRUCTION METHODS

A. Fence Type 1: Filter Fabric: Barrier

1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory preassembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.
2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on Drawings may also be used.
3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.
4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.
5. Backfill and compact trench.

B. Barrier Type 2: Reinforced Filter Fabric Barrier

1. Layout barrier same as for Type 1.
2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.
3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.
4. Install trench same as for Type 1.
5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.
6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.

7. Backfill and compact trench.
8. Attach filter fabric to wooden fence stakes spaced a maximum of 6 feet apart or steel fence stakes spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install stakes at a slight angle toward source of anticipated runoff.
9. Trench in toe of filter fabric barrier with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.
10. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.
11. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with minimum 6 inch overlap and seal securely.
12. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in Channel from overtopping bank.

C. Triangular Filter Fabric Barrier Construction Methods

1. Attach filter fabric to wire fencing, 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.
2. Secure triangular fabric filter barrier in place using one of the following methods:
3. Toe-in skirt 6 inches with mechanically compacted material
4. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock or
5. Trench-in entire structure 4 inches.
6. Anchor triangular fabric filter barrier structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.
7. Lap fabric filter material by 6 inches to cover segment joints. Fasten joints with galvanized shoat rings.

3.05 DIKE AND SWALE

A. Unless otherwise indicated, maintain minimum dike height of 18 inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.
B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected.
C. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.
D. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.
E. Clear in accordance with Section 31 23 33 - Clearing and Grubbing Compact embankments in accordance with Section 31 23 33 - Roadway Excavation.
F. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom.

Excavation slopes shall be 2:1 or flatter. Clear, grub and strip excavation area of vegetation and root material.

3.06 DOWN SPOUT EXTENDER

A. Down spout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in accordance with Section 33 05 39 - Bedding and Backfill for Utilities.

3.07 PIPE SLOPE DRAIN

A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.
B. Inlet pipe shall have slope of 1 percent or greater. Use pipe diameter as shown on the Drawings.
C. C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at
D. least 1 foot higher at all points than top of inlet pipe.
E. Pipe shall be secured with hold-down grommets spaced 10 feet on centers.
F. Place riprap apron with a depth equal to pipe diameter with 2:1 side slopes.

3.08 PAVED FLUME

A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.
B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.
C. Construct permanent paved flumes in accordance with Drawings.
D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

3.09 LEVEL SPREADER

A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.
B. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities which will impede normal flow.

3.10 INLET PROTECTION BARRIER

A. Place sandbags for Stage I, Bagged gravel for Stage II and filter fabric barriers at locations shown on the SWP3. Maintain to allow minimal inlet in flow restrictions / blockage during storm event.

3.11 DROP INLET BASKET CONSTRUCTION METHODS

A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SWP3.
B. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.
C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least 6 inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.
D. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

3.12 HAY BALE FENCE CONSTRUCTION METHODS

A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.
B. Embed bale in soil a minimum of 4 inches.
C. Securely anchor bales in place with Hay Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.
D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.
E. Replace with new hay bale fence every two months or as required by Project Manager.

3.13 BRUSH BERM CONSTRUCTION METHODS

A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.
B. Use woody brush and branches having diameter less than 2-inches with 6- inches overlap. Avoid incorporation of annual weeds and soil into brush berm.
C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.
D. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

3.14 STREET AND SIDEWALK CLEANING

A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Section 31 25 03- Stabilized Construction Exit.
B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not waterhose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.15 WASTE COLLECTION AREAS

A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.16 EQUIPMENT MAINTENANCE AND REPAIR

A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.
B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.17 VEHICLE/ EQUIPMENT WASHING AREAS

A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction access, as required to prevent mud and dirt run-off. Release wash water into drainage

swales or inlets protected by erosion and sediment controls. Build wash areas following Section 31 25 03- Stabilized Construction access. Install gravel or rock base beneath wash areas.

B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into waterways or storm water conveyance systems.
C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.18 WATER RUNOFF AND EROSION CONTROL

A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties. Follow environment requirements.
B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.
C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
D. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to
E. control conditions.
F. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.

1. Hold area of bare soil exposed at one time to a minimum.
2. Provide temporary controls such as berms, dikes, and drains.

G. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.
H. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.
I. Dispose of sediments offsite, not in or adjacent to waterways or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.
J. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8- inch layers. Provide compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density.
K. Make at least one test per 500 cubic yards of embankment.
L. Prohibit equipment and vehicles from maneuver on areas outside of dedicated rights- of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic. K. Do not damage existing trees intended to remain.

3.19 REMOVAL OF CONTROLS

A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Project Manager.
B. Dispose of sediments and waste products following Section 02 41 13 -Temporary Facilities.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 01 58 13
Project Signs

PART 1 - GENERAL

1.01 SUMMARY

A. Requirements for installation, maintenance and removal of the project identification sign and for the Construction Site Notice (CSN) holder.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related item listed on the Unit Price Schedule.
B. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.

PART 2 - PRODUCTS

2.01 PROJECT SIGNS

A. Provide project identification sign at each construction entrance from public roadways. Sign will include project name, City of West University Place logo, contractor name and contact information, project manager name and contact information, and link to OWNER project web page.
B. CSN Holder(s):
C. Place laminated Construction Site Notice on front of notice holder.

2.02 SUPPORTS

A. Project Identification Sign:

1. Provide (0.4) pressure treated 12 feet long, 4 inch by 4 inch posts with appropriate hardware. Paint posts white.

B. Construction Site Notice Holder(s):

1. Provide (0.4) pressure treated 4 feet long 2 inch by 4 inch lumber to secure notice holder. Paint posts white.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. CSN Holder(s):

1. Construct notice CSN holder from 1.5 foot by 1.5 foot by ¾ inch thick exterior grade (EXT BC) plywood. Paint white.
2. Bolt notice holder to 2 by 4 inch posts with 2 hot-dipped galvanized screws per post. Paint posts white.
3. Staple laminated Construction Site Notice to front of notice holder.
4. Place CSN holder at each entrance to the construction site.

3.02 INSTALLATION (WHEN REQUIRED)

A. Project Sign(s):

1. Install Project Identification sign(s) and Construction Site Notice holder(s) prior to construction start.
2. Install, relocate when required, and maintain all project signs for duration of Project.
3. Install sign(s) at location(s) designated by the Engineer or where shown on the Plans. Position the sign(s) in such a manner as to be fully visible and readable by the general public.
4. Install sign(s) level and plumb.

B. Project Identification Sign(s):

1. Mount each Project Identification sign on two 12 feet long 4 inch by 4 inch posts; Install in the ground a minimum of 30 inches.
2. CSN Holder(s):
3. Drive supports a minimum of 1 foot into ground.

3.03 MAINTENANCE

A. Maintain signs and supports.
B. Report deterioration or damage to the Project Identification sign(s)
C. Project Identification sign(s). If required, install new sign(s) at no cost to the Owner.
D. Maintenance and replacement of the CSN holder(s) responsibility at no additional cost to the Owner.

3.04 REMOVAL

A. Upon completion of project, remove Project Identification sign(s) and supports. Transport sign and supports to designated location, as directed by the Engineer. Restore the area prior to final payment.
B. Remove and dispose of non-reusable foundation material. Refer to Section 02 41 13 - Material Disposal.
C. CSN holder(s) are to remain in place after final payment, unless directed otherwise by the Engineer.

END OF SECTION

SECTION 01 62 00
SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 - GENERAL

1.01 CONTRACTOR'S OPTIONS:

A. For products specified only by reference standards, select any product meeting standards.

B. For products specified by naming several products or manufacturers, select any names.

C. For products specified by naming one or more products, followed by "or equal", Contractor must submit request for substitution for any product not specifically named.

D. For products specified by naming only one product and manufacturer, no option and no substitution will be allowed.

1.02 SUBSTITUTIONS:

A. Two weeks prior to the bid date, the Engineer will consider formal requests from Contractor for substitution of products in place of those specified. Request received less than two calendar weeks prior to the bid opening time will be returned unopened and not considered. Requests must arrive at the Engineers office prior to the deadline.

B. Submit **five (5)** hard copies of each request for substitution, including:

1. Complete data substantiating compliance of proposed substitution with Contract Documents.

2. For products:

a. Product identification, including name and address of manufacturer.
b. Product description, performance and test data, and reference standards.

3. For construction methods:

a. Detailed description of proposed method.
b. Illustration drawings.

4. Changes in construction schedule.

5. Accurate cost data in comparison with product or method specified.

C. In making request for substitution, Contractor represents that:

1. He has investigated proposed substitution and determined that it is equal or superior to that specified in all aspects.

2. He will provide same warranty as for product or method specified.

3. He will coordinate installation of accepted substitution into Work, making changes as may be required to complete work in all aspects.

4. He waives all claims for additional costs related to substitution which subsequently become apparent.

5. Cost data is complete and includes all related costs under Contract, excluding Engineer's redesign.

6. The project plans and specifications are based on the specified equipment. Should the Contractor choose to use an "alternate" or "or equal" manufacturer, all costs for redesign must be included in the Contractor's bid amount. These costs shall include Engineer's expenses for revisions to civil, electrical, mechanical, and structural drawings and all other engineering fees associated with review and approval of the revised drawings. These fees may also include any costs for subsequent re-submission and review by the Texas Commission on Environmental Quality (TCEQ). Submittal drawings for "alternate" or "or equal" systems must be stamped by a Professional Engineer (PE) licensed in the state where the project is located.

D. Substitutions will not be considered if:

1. They are indicated or implied on shop drawings or data submittals without formal request.

2. Acceptance will require substantial revision of Contract Documents.

E. Contractor alone will be responsible for substantiating acceptability of proposed substitutions. Engineer's decision in acceptance or non-acceptance of substitutions shall be final.

END OF SECTION

REQUEST FOR SUBSTITUTION FORM:

TO: _____

PROJECT: _____ DATE: _____

We hereby submit for your consideration the following product instead of the specified item for the above project:

SECTION	PARAGRAPH	SPECIFIED ITEM

Proposed Substitution: _____

Reason for Substitution: _____

Include complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

Fill in Blanks Below:

A. Will the undersigned contractor pay for changes to the building design, including engineering and detailing costs caused by the requested substitution?

   _____

B. What effect does substitution have on other trades?

   _____

C. Differences between proposed substitution and specified item?

   _____

D. Differences in product cost or product delivery time?

   _____

E. Manufacturer's guarantees of the proposed and specified items are:

_____ Equal _____ Better (explain on attachment)

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

Submitted By:

Signature _____

Firm _____

Address _____

Date _____

Telephone _____

For Use by Engineer

___ Recommended ___ Recommended as noted

___ Not recommended ___ Received too late

By _____

Date _____

Remarks _____

_____

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SECTION 01 74 00
CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: Throughout the construction period, maintain the buildings and site in a standard of cleanliness as described in this Section.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

2. In addition to standards described in this Section, comply with the requirements for cleaning as described in pertinent other Sections of these Specifications.

1.02 QUALITY ASSURANCE:

A. Conduct daily inspection, and more often if necessary, to verify that requirements for cleanliness are being met.

B. In addition to the standards described in this Section, comply with pertinent requirements of governmental agencies having jurisdiction.

PART 2 - PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT:

A. Provide required personnel, equipment, and materials needed to maintain the specified standard of cleanliness.

2.02 COMPATIBILITY:

A. Use only the cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material.

PART 3 - EXECUTION

3.01 PROGRESS CLEANING:

A. General:

1. Retain stored items in an orderly arrangement allowing maximum access, not impeding traffic or drainage, and providing required protection of materials.

2. Do not allow accumulation of scrap, debris, waste material, and other items not required for construction of this Work.

3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the job site.

4. Provide adequate storage for all items awaiting removal from the job site, observing requirements for fire protection and protection of the ecology.

B. Site:

1. Daily, and more often if necessary, inspect the site and pick up all scrap, debris, and waste material. Remove such items to the place designated for their storage.

2. Weekly, and more often if necessary, inspect all arrangements of materials stored on the site. Restack, tidy, or otherwise service arrangements to meet the requirements of subparagraph 3.01-A-1 above.

3. Maintain the site in a neat and orderly condition at all times.

C. Structures:

1. Weekly, and more often if necessary, inspect the structures and pick up all scrap, debris, and waste material. Remove such items to the place designated for their storage.

2. Weekly, and more often if necessary, sweep interior spaces clean.

   a. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and a hand-held broom.

3. As required preparatory to installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using equipment and materials required to achieve the necessary cleanliness.

4. Following the installation of finish floor materials, clean the finish floor daily (and more often if necessary) at all times while work is being performed in the space in which finish materials are installed.

   a. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from foreign material which, in the opinion of the Engineer, may be injurious to the finish floor material.

3.02 FINAL CLEANING:

A. "Clean", for the purpose of this Article, and except as may be specifically provided otherwise, shall be interpreted as meaning the level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials.

B. Prior to completion of the Work, remove from the job site all tools, surplus materials, equipment, scrap, debris, and waste. Conduct final progress cleaning as described in Article 3.01 above.

C. Site:

1. Unless otherwise specifically directed by the Engineer, broom clean paved areas on the site and public paved areas adjacent to the site.

2. Completely remove resultant debris.

D. Structures:

1. Exterior:

a. Visually inspect exterior surfaces and remove all traces of soil, waste materials, smudges, and the foreign matter.

b. Remove all traces of splashed materials from adjacent surfaces.

c. If necessary to achieve a uniform degree of cleanliness, hose down the exterior of the structure.

d. In the event of stubborn stains not removable with water, the Engineer may require light sandblasting or other cleaning at no additional cost to the Owner.

2. Interior:

a. Visually inspect interior surfaces and remove all traces of soil, waste materials, smudges, and other foreign matter.

b. Remove all traces of splashed material from adjacent surfaces.

c. Remove paint droppings, spots, stains, and dirt from finished surfaces.

3. Glass: Clean inside and outside.

4. Polished surfaces: To surfaces requiring routine application of buffed polish, apply the polish recommended by the manufacturer of the material being polished.

E. Schedule final cleaning as approved by the Engineer to enable the Owner to accept a completely clean Work.

3.03 CLEANING DURING OWNER'S OCCUPANCY:

A. Should the Owner occupy the Work or any portion thereof prior to its completion by the Contractor and acceptance by the Owner, responsibilities for interim and final cleaning shall be as determined by the Engineer in accordance with the General Conditions of the Contract.

END OF SECTION

SECTION 01 74 16
SITE MAINTENANCE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK INCLUDED IN THIS SECTION:

A. Fine Grading

B. Soil Preparation

C. Hydro Mulching

D. Maintenance

E. Warranty

1.02 QUALITY ASSURANCE:

A. Contractor to follow standards set forth in the following references:

1. American Standard for Nursery Stock published by American Association of Nurserymen; October 27, 1980, Edition.

2. American Joint Committee on Horticultural Nomenclature; 1942 Edition of Standardized Plant Names.

1.03 SUBMITTALS:

A. Contractor shall submit for inspection the following items:

1. Receipts for all fertilizer and seed mixture.

2. Method of temporary irrigation for areas not included in permanent irrigation system limits.

1.04 WARRANTY:

A. Provide a uniform stand of grass by watering, mowing, and maintaining lawn areas for a period of 120 calendar days after project final walk-thru. Re-seed seeded areas which fail to provide a uniform stand of grass, reseed with specified materials until all affected areas are accepted by the Engineer.

PART 2 - PRODUCTS

2.01 FERTILIZER:

A. Fertilizer shall meet all requirements of Item 202.4

2.02 LAWN SEED:

A. Lawn Seed: Fresh, clean and new crop seed mixture.

1. Provide fresh, clean, new crop hulled seed tested to minimum percentages of purity and germination as established by Official Seed Analysts of North America. Provide seed of grass species, proportions and maximum percentages of purity, germination and be free of: Poa Annua, bent grass, and noxious weed seed.

a. Bermuda Grass, 98% purity, 90% germination. Assure that seed has been soaked in salt peter or other medium which will accelerate germination to a minimum time period.

Rate: 4 pounds per 1,000 square feet.

2. Fall Seed will only be allowed by approval of the Owner.

2.03 WATER:

A. Free of substance harmful to plant growth. Hoses, pumps, sprinklers or other methods of transportation furnished by contractor, to be approved by the Engineer prior to installation (reference 1.03). A temporary irrigation system may be necessary for proper establishment of vegetation which will be the sole responsibility of the Contractor.

PART 3 - EXECUTION

3.01 FINISH GRADING:

A. Finished Grades: Shall be understood to be final spot grades and contours indicated on the contract drawings. Where final spot grades or new contours are not indicated, finished grades shall be uniformly level or sloping between points for which elevations are given or contours are shown.

B. Fine Grading Lawn Areas: Bring the grade of areas to receive turf to a uniform, level slope, as determined by the use of surveying instruments, by disking, harrowing and other methods approved by the Engineer. When establishing finish grades, remove and dispose of all clods, hard lumps, rocks, roots, litter and other foreign matter not passing through the teeth of a hand iron rake. Tractor drawn raking equipment that compacts lawn areas will not be allowed.

C. Settlement: Maintain ground surfaces to the finish grades shown on the contract drawings until the date of final acceptance.

3.02 SEEDING:

A. Seeding Limits: Disturbed Areas not shown for pavement, gravel, or other surfaces.

B. Responsibility: Utilize all measures as may be necessary, including, but not limited to, protective fencing, sod, or erosion control netting to produce a finished continuous blanket of turf over tall areas designated to receive turf.

C. Fertilizer: No fertilizer shall be applied prior to seeding.

D. Seeding Operations:

1. Seed immediately after preparation of bed. Spring seeding between March 1 and June 1, and Fall seeding between august 15 and October 15, or at such other times acceptable to the Owner.

2. Perform seeding operations when the soil is dry and when winds do not exceed 5 miles per hour velocity.

3. Apply seed evenly by sowing equal quantities in two directions, at right angles to each other.

4. Sow grass at specified rate.

5. After seeding, lightly rake or drag surface of soil to incorporate seed into top 1/8" of soil. Roll with light lawn roller.

3.03 HYDRO MULCHING:

A. Hydro Mulching Limits: As indicated on the drawings. Seed or seed mixture shall be uniformly distributed over the areas shown.

B. Responsibility: The contractor shall utilize all such measures as may be necessary, including, but not limited to, protective fencing or erosion control netting to produce a finished continuous blanket of turf over all areas designated to receive turf.

C. Hydro Mulching Operations:

1. Seed and fertilizer are to be distributed as a water slurry, and the mixture shall be applied to the area within 30 minutes after all components are placed in the equipment.

2. After planting, the seed shall be raked or harrowed into the soil to a depth of approximately ¼ inch.

3. The planted areas shall then be rolled with a smooth roller, developing 15 to 25 psi contact pressure upon the planted surface area and giving a smooth surface without ruts or tracks.

4. After compacting is completed, the planted area shall be watered sufficiently to assure uniform moisture from the surface to a minimum of six inches in depth.

3.04 LAWN AND MAINTENANCE:

A. Maintain seeded areas for a period of at least 120 days after final acceptance of the project.

B. Maintain seeded lawn areas, including watering, spot weeding, mowing, applications of herbicides, fungicides, insecticides and reseeding until a full, uniform stand of grass free of weeds, undesirable grass species, disease and insects is achieved. A temporary irrigation system may be necessary for

proper establishment of vegetation which will be the sole responsibility of the Contractor.

C. Repair, rework, and reseed all areas that are washed out, eroded, or do not catch.

D. Fertilize with organic fertilizer after germination, but prior to first mowing.

E. Mow lawn areas as soon as lawn top growth exceeds a 3" height. Cut back to 2 1/2" in height. Repeat mowing as required to maintain specified height.

F. No lawn areas shall have bare spots or unacceptable cover totaling more than 2% of the area.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: Provide an orderly and efficient transfer of the completed Work to the Owner.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

A. Prior to requesting inspection by the Engineer, use adequate means to assure that the Work is completed in accordance with the specified requirements and is ready for the requested inspection.

1.03 PROCEDURES:

A. Final Walk Through:

1. The Engineer and the Contractor will prepare a list of items to be completed by the Contractor.

2. Within a reasonable time after receipt of the list, the Engineer will inspect to determine status of completion.

3. Should the Engineer determine that the Work is not substantially complete:

a. The Engineer promptly will so notify the Contractor, in writing, giving the reasons therefore.

b. Remedy the deficiencies and notify the Engineer when ready for reinspection.

c. The Engineer will reinspect the Work.

4. When the Engineer concurs that the Work is substantially complete:

a. The Engineer will prepare a Letter accompanied by the Contractor's list of items to be completed or corrected, as verified by the Engineer.

b. The Engineer will submit the Letter to the Owner and to the Contractor for their written acceptance of the responsibilities assigned to them in the Letter.

c. Contractor shall have a maximum of four weeks to complete the assigned tasks on the final punch list.

B. Final Completion:

1. Prepare and submit notice.

2. Verify that the Work is complete.

3. Certify that:

   a. Contract Documents have been reviewed;
   b. Work has been inspected for compliance with the Contract Documents;
   c. Work has been completed in accordance with the Contract Documents;
   d. Equipment and systems have been tested as required, and are operational;
   e. Work is completed and ready for final inspection.

4. The Engineer will make an inspection to verify status of completion.

5. Should the Engineer determine that the Work is incomplete or defective:

   a. The Engineer promptly will so notify the Contractor, in writing, listing the incomplete or defective work.

   b. Remedy the deficiencies promptly, and notify the Engineer when ready for reinspection.

6. When the Engineer determines that the Work is acceptable under the Contract Documents, he will request the Contractor to make close-out submittals.

C. Close-out submittals include, but are not necessarily limited to:

1. Project Record Documents described in Section 01 78 39;

2. Operation and maintenance data for items so listed in pertinent other Sections of these Specifications, and for other items when so directed by the Engineer;

3. Warranties and bonds;

4. Keys and keying schedule;

5. Spare parts and materials extra stock;

6. Evidence of compliance with requirements of governmental agencies having jurisdiction including, but not necessarily limited to:

   a. Certificates of Inspection;
   b. Certificates of Occupancy.

7. Certificates of Insurance for products and completed operations;

8. Evidence of payment and release of liens;

9. List of subcontractors, service organizations, and principal vendors, including names, addresses, and telephone numbers where they can be reached for emergency service at all times including nights, weekends, and holidays.

D. Final adjustment of accounts:

1. Submit a final statement of accounting to the Engineer, showing all adjustments to the Contract Sum.

2. If so required, the Engineer will prepare a final Change Order showing adjustments to the Contract Sum which were not made previously by Change Orders.

1.04 INSTRUCTIONS:

A. Instruct the Owner's personnel in proper operation and maintenance of systems, equipment, and similar items which were provided as part of the Work. Contractor shall be responsible for arranging for the instructions and supervision at a time convenient to the Owner or his representatives.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 01 77 00

WARRANTY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Compliance and administrative procedures for completion and warranty of work. For developer driven projects the Engineer of Record shall assume the responsibilities of Project Manager, unless otherwise noted.

1.2 PRICE AND PAYMENT PROCEDURES [NOT USED]

1.3 REFERENCES

A. Reference Standards

1. Texas Department of Licensing and Regulation (TDLR) inspection for Texas Accessibility Standards (TAS) compliance.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Compliance

1. Comply with Approved Construction Documents regarding Date of Substantial Completion when Contractor considers the Work, or portion thereof designated by Project Manager, to be substantially complete.
2. Insure the following items have been completed when included in the Work, prior to presenting a list of items to be inspected by Project Manager for issuance of a Certificate of Substantial Completion:
   a. Cutting, plugging, and abandoning of water, wastewater, and storm sewer lines, as required by Contract documents for each item.
   b. Construction of, and repairs to, pavement, driveways, sidewalks, and curbs and gutters.
   c. Sodding and hydromulch seeding, unless waived by Project Manager in writing.
   d. General clean up including pavement markings, transfer of services, successful testing and landscape.
   e. Additional requirements contained in Section 01 11 00 - Summary of Work.
3. Assist Project Manager with inspection of Contractor's list of items and complete or correct the items, including items added by Project Manager, within specified time period. For developer driven projects this will
4. Should Project Manager's inspection show failure of Contractor to comply with requirements to obtain Date of Substantial Completion, including those items in Paragraph 1.02 B. of this section, Contractor shall complete or correct the items, before requesting another inspection by Project Manager.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. Approval Process
   1. For CIP projects: All submittals shall be approved by the City Engineer prior to delivery
   2. For developer-driven projects: All submittals shall be confirmed by the City Engineer after review and recommendation from the Engineer of Record. City Engineer confirmational shall be obtained prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS [NOT USED]

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data
   1. Submit O&M data as noted in Section 01 33 00.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts
   1. Provide Products, spare parts, maintenance and extra materials in quantities specified in individual Specification sections.
   2. Deliver to a location within the City limits as directed by Project Manager. Applicable items must be delivered prior to issuance of a final Certificate for Payment.

1.9 QUALITY ASSURANCE

A. Qualifications
   1. Licensed Professionals
      a. Prior to requesting inspection by the ENGINEER, use adequate means to assure that the Work is completed in accordance with the specified requirements and is ready for the requested inspection.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements
   1. Secure and maintain a location to store the material in accordance with Section 01 66 00.

1.11 SITE CONDITIONS [NOT USED]

1.12 WARRANTY

A. Manufacturer Warranty
   1. Provide one original of each warranty from Subcontractors, Suppliers, and manufacturers.
   2. Provide Table of Contents and assemble warranties in a 3-ring/D binder with durable plastic cover or submitted digitally in pdf format.
   3. Warranty Submission
      a. For CIP projects: Submit warranties prior to final progress payment.
      b. For developer-driven projects: Submit warranties prior to final approval.

B. Warranty of Work

1. The Developer, the contractor and/or his surety will be required by the City Engineer to repair, replace restore and/or make to comply strictly in all things with these specifications and the plans and any and all work and/or materials, which within a period of two year from and after the date of the passing approval and/or acceptance of any such work or material, are found to be defective or to fail in any way to comply with these specifications.
2. Effective date for beginning two-year guarantee shall be the date of the City acceptance or the permit of occupancy for the facility.
3. Should the Developer/Contractor fail to remedy the defects as outlined herein within a reasonable length of time, the City may have such work done and charge the cost to the Developer/Contractor or the surety company.

PART 2 - PRODUCTS [NOT USED]

2.1 CITY-FURNISHED [OR] CITY-SUPPLIED PRODUCTS [NOT USED]

A. New Products

B. Existing Products

PART 3 - EXECUTION

3.1 ADJUSTING

A. Equipment (CIP Projects Only)

1. Adjust operating equipment to ensure smooth and unhindered operation. Value of this testing and adjusting is five percent of Lump Sum Price in the Schedule of Values for item being tested.

3.2 CLEANING

A. Procedures

1. Execute final cleaning prior to final inspection.
2. For facilities, clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
3. Clean equipment and fixtures to sanitary condition.
4. Clean or replace filters of operating equipment.
5. Clean debris from roofs, gutters, down spouts, and drainage systems.
6. Clean site: sweep paved areas and rake clean landscaped surfaces.
7. Remove waste and surplus materials, rubbish, SWPPP equipment, and temporary construction facilities from site following final test of utilities and completion of the Work.

3.3 CLOSEOUT ACTIVITIES

A. Procedures

1. Provide Project Record Documents in accordance with Section 01 78 39 - Project Record Documents.
2. Complete or correct items on punch list, with no new items added.
3. The City will occupy portions of the Work as specified in other sections.

B. Final Walk Through

1. The ENGINEER and the CONTRACTOR will prepare a list of items to be completed by the CONTRACTOR.
2. Within a reasonable time after receipt of the list, the ENGINEER will inspect to determine status of completion.
3. Should the ENGINEER determine that the Work is not substantially complete:
   a. The ENGINEER promptly will so notify the CONTRACTOR, in writing, giving the reasons therefore.
   b. Remedy the deficiencies and notify the ENGINEER when ready for re-inspection.
   c. The ENGINEER will re-inspect the Work.
4. When the ENGINEER concurs that the Work is substantially complete:
   a. The ENGINEER will prepare a Letter accompanied by the CONTRACTOR's list of items to be completed or corrected, as verified by the ENGINEER.
   b. The ENGINEER will submit the Letter to the OWNER and to the CONTRACTOR for their written acceptance of the responsibilities assigned to them in the Letter.
   c. CONTRACTOR shall have a maximum of four (4) weeks to complete the assigned tasks on the final punch list.

C. Final Completion

1. Prepare and submit notice.
2. Verify the Work is complete.

END OF SECTION

SECTION 01 78 23
DIGITAL OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included:

1. Throughout progress of the Work, assemble data for inclusion in an Operation and Maintenance Manual.

2. Upon completion of the Work, submit Operation and Maintenance Manuals to the Engineer, as described in Article 3.01 below.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, Sections in Division 1 of these Specifications.

2. Other requirements affecting Operation and Maintenance Data may appear in pertinent other Sections of these Specifications.

1.02 SUBMITTALS:

A. Comply with pertinent provisions of Section 01 33 23.
   1. Provide 2 sets of hard copy Operation and Maintenance Manuals.
   2. Provide Operation and Maintenance manuals in electronic format.

PART 2 - PRODUCTS

2.01 PRE-APPROVED PROVIDERS

A. Cognica (an RSK company): contact Melissa Quarterman melissa.quarterman@cognica.com.
B. Deliverables from alternate provider shall not be acceptable unless pre-approved two weeks prior to bid date per Section 01 62 00 Substitutions and Product Options.

PART 3 - EXECUTION

3.01 BOUND MANUALS

A. Organize operating and maintenance data into suitable sets of manageable size.
B. Bind data into individual binders properly identified and indexed.
C. Bind each set of data in a new heavy-duty 2-inch or 3-inch, 3-ring vinyl-covered binder, with typed tabs for each specification section, and with pocket folders for folded sheet information.

D. Mark the appropriate identification on both front and spine of each binder.
E. Provide a cabinet in the pump room for storage of O&M Manuals, see plans for location.

3.02 HARD-COPY FORMAT:

A. Size: 8-1/2 in. x 11 in.
B. Text: Manufacturer's printed data, or neatly typewritten.
C. Provide typed description of product, and major component parts of equipment.

3.03 DRAWINGS:

A. Provide reinforced punch binder tab, bind in with text.
B. Fold larger drawings to the size of the text pages.
C. Provide fly-leaf for each separate product, or each piece of operating equipment.

3.04 DIGITAL FORMAT:

A. Digital files will be searchable for key word text and organized in a system.
B. Provide an online interface accessible by City employees from desktop or mobile phones. Include one year of maintenance fees after final completion of the WWTP.

3.05 COVER: IDENTIFY EACH VOLUME WITH TYPED OR PRINTED TITLE "OPERATING AND MAINTENANCE INSTRUCTIONS".

A. Plant Operation Manual

1. Provide custom consolidated operations and maintenance manuals incorporating the key information for all installed equipment regardless of manufacturer and providing an overall operation guidebook with various scenarios for treatment.
2. Describe specific settings and operational parameters for this specific WWTP for normal flow, high rainfall flow, and upset events.

B. List:

1. Title of Project.
2. Identity of separate structure as applicable.
3. Identity of general subject matter covered in the manual.

C. Include the following types of information in operation and maintenance manuals:

1. Description of unit and component parts.
   Function, normal operating characteristics, and limiting conditions.
   Performance curves, engineering data and tests.
   Complete nomenclature and commercial number of all replaceable parts.
2. Operating procedures:
   Start-up, break-in, routine and normal operating instructions.
   Regulation, control, stopping, shut-down and emergency instructions.
   Summer and winter operating instructions.

Alignment, adjusting and checking.

3. Servicing and lubrication schedule:
   List of lubricants required for each piece of equipment.
4. Overall schedule for manufacturer recommended preventative maintenance.
   Manufacturer's printed operating and maintenance instructions.
   Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
   Other data as required under pertinent sections of specifications.
5. Emergency instructions.
6. Spare parts listing.
7. Copies of warranties.
8. Wiring diagrams.
9. Recommended "turn-around" cycles.
10. Inspection procedures.
11. Shop drawings and product data.

END OF SECTION

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included:

1. Throughout progress of the Work, maintain an accurate record of changes in the Contract Documents, as described in Article 3.01 below.

2. Upon completion of the Work, transfer the recorded changes to a set of Final Project Record Documents, as described in Article 3.02 below.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

2. Other requirements affecting Project Record Documents may appear in pertinent other Sections of these Specifications.

1.02 QUALITY ASSURANCE:

A. Delegate the responsibility for maintenance of Project Record Documents to one person on the Contractor's staff as approved by the Engineer.

B. Accuracy of records:

1. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where such entry is required to show the change properly.

2. Accuracy of records shall be such that future search for items shown in the Contract Documents may rely reasonably on information obtained from the approved Project Record Documents.

C. Make entries within 24 hours after receipt of information that the change has occurred.

1.03 SUBMITTALS:

A. Comply with pertinent provisions of Section 01 33 23.

B. The Engineer's approval of the current status of Project Record Documents may be a prerequisite to the Engineer's approval of requests for progress payment and request for final payment under the Contract.

C. Prior to submitting each request for progress payment, secure the Engineer's approval of the current status of the Project Record Documents.

D. Prior to submitting request for final payment, submit the Final Project Record Documents to the Engineer and secure his approval.

1.04 PRODUCT HANDLING:

A. Maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the Work and transfer of all recorded data to the Final Project Record Documents.

B. In the event of loss of recorded data, use means necessary to again secure the data to the Engineer's approval.

1. Such means shall include, if necessary in the opinion of the Engineer, removal and replacement of concealing materials.

2. In such case, provide replacements to the standards originally required by the Contract Documents.

PART 2 - PRODUCTS

2.01 RECORD DOCUMENTS:

A. Job set: Promptly following receipt of the Owner's Notice to Proceed, secure from the Engineer at no charge to the Contractor one complete set of all Documents comprising the Contract.

B. Final Project Record Documents: At a time nearing the completion of the Work, secure from the Engineer at no charge to the Contractor one complete set of all Drawings in the Contract.

PART 3 - EXECUTION

3.01 MAINTENANCE OF JOB SET:

A. Immediately upon receipt of the job set described in Paragraph 2.01-A above, identify each of the Documents with the title, "RECORD DOCUMENTS - JOB SET".

B. Preservation:

1. Considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed, devise a suitable method for protecting the job set to the approval of the Engineer.

2. Do not use the job set for any purpose except entry of new data and for review by the Engineer, until start of transfer of data to Final Project Record Documents.

3. Maintain the job set at the site of Work as that site is designated by the Engineer.

C. Making entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required.

2. Date all entries.

3. Call attention to the entry by a "cloud" drawn around the area or areas affected.

4. In the event of overlapping changes, use different colors for the overlapping changes.

D. Make entries in the pertinent other Documents as approved by the Engineer.

E. Conversion of schematic layouts:

1. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items, is shown schematically and is not intended to portray precise physical layout.

   a. Final physical arrangement is determined by the Contractor, subject to the Engineer's approval.

   b. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the Drawings.

2. Show on the job set of Record Drawings, by dimension accurate to within one inch, the centerline of each run of items such as are described in subparagraph 3.01-E-1 above.

   a. Final physical arrangement is determined by the Contractor, subject to the Engineer's approval.

   b. Show, by symbol or note, the vertical location of the Item ("under slab", "in ceiling plenum", "exposed", and the like).

   c. Make all identification sufficiently descriptive that it may be related reliably to the Specifications.

3. The Engineer may waive the requirements for conversion of schematic layouts where, in the Engineer's judgment, conversion serves no useful purpose. However, do not rely upon waivers being issued except as specifically issued in writing by the Engineer.

3.02 FINAL PROJECT RECORD DOCUMENTS:

A. The purpose of the Final Project Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive site measurement, investigation, and examination.

B. Approval of recorded data prior to transfer:

1. Following receipt of the Final Project Record Documents described in Paragraph 2.01-B above, and prior to start of transfer of recorded data thereto, secure the Engineer's approval of all recorded data.

2. Make required revisions.

C. Transfer of data to Drawings:

1. Carefully transfer change data shown on the job set of Project Record Drawings to the corresponding Final Project Record Documents, coordinating the changes as required.

2. Clearly indicate at each affected detail and other Drawings a full description of changes made during construction, and the actual location of items described in subparagraph 3.01 above.

3. Call attention to each entry by drawing a "cloud" around the area or areas affected.

4. Make changes neatly, consistently, and with the proper media to assure longevity and clear reproduction.

D. Transfer of data to other Documents:

1. If the Documents other than Drawings have been kept clean during progress of the Work, and if entries thereon have been orderly to the approval of the Engineer, the job set of those Documents other than Drawings will be accepted as Final Project Record Documents.

2. If any such Document is not so approved by the Engineer, secure a new copy of that Document from the Engineer at the Engineer's usual charge for reproduction and handling, and carefully transfer the change data to the new copy to the approval of the Engineer.

E. Review and submittal:

1. Submit the completed set of Project Record Documents to the Engineer as described in Paragraph 1.03-D above.

2. Participate in review meetings as required.

3. Make required changes and promptly deliver the Final Project Record Documents to the Engineer.

3.03 CHANGES SUBSEQUENT TO ACCEPTANCE:

A. The Contractor has no responsibility for recording changes in the Work subsequent to Final Completion, except for changes resulting from work performed under Warranty.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 02 08 01
Site Preparation and Restoration

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION includes requirements for construction preparation, and final site cleanup/restoration.

1.02 MEASUREMENT AND PAYMENT

A. Where there is not a separate item listed on the Unit Price Schedule for work in this Section, no separate measurement and payment is made.
B. Include cost for work under this Section in the related item(s) listed on the Unit Price Schedule.
C. Payment will be on the following schedule:

1. Payment of the lump sum price established in the Bid Form will be made at the applicable lump sum amount, as above determined, and will represent full compensation for all mobilization in accordance with the Specifications
2. The maximum allowable amount of this bid item shall be 3 percent (3%) of the total base bid amount not including mobilization and allowance items
3. Partial payments for the Mobilization item will be made with the first and third partial pay estimates paid on the contract, and will be made at the rate of 50% of the lump sum price for Mobilization on each of these partial pay estimates.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 GENERAL

A. Establish and maintain access to the site.
B. Install, remove, relocate, replace and reinstall fences, barricades, guard rails or barriers required to secure the site.
C. Secure the site as necessary to perform the Work.
D. Maintain all-weather access to adjacent facilities that have driveways.
E. Maintain access and drainage continuously for duration of the project.
F. Protect items designated for preservation from abuse, marring or damage during construction operations.
G. At no cost to the Owner, remove temporary items restricting the use of OWNER facilities for their intended purpose when Project is under a National Weather Service Flood Watch or when directed by the Engineer when needed to protect the public and public infrastructure.
H. Remove structures, abandoned utility lines and related obstructions to a depth of 2 feet below the finished grade.

I. Collect tires, batteries, paint cans, oil cans and related items found on the right-of-way in a location approved by the Engineer, for disposal by others.
J. Inform the Engineer of possibly hazardous material found on site for assessment and handling/disposal by others.
K. Remove structures, outfall pipes, drainage facilities and other items that may interfere with the construction work or as designated on the Plans.
L. Clean up and restore the site.
M. When Work is finished, remove existing Owner signs and reinstall in an approved location or deliver the sign to an Owner facility when directed by the Engineer.

3.02 ABANDONED UTILITY LINES

A. Refer to Section 02 41 13 - Material Disposal.
B. Notify the utility owner prior to work on such abandoned lines.
C. Remove abandoned utility lines that may interfere with the construction work or as designated on the Plans.
D. Plug and abandon utility lines left in place as approved by the Engineer.

3.03 ENCROACHMENTS

A. Fences and/or other encroachments in the Owner right-of-way are not to be removed unless otherwise stated on the plans.
B. Encroachments identified for removal must be removed prior to any other work on the site. Coordinate with property owners at least 24 hours prior to any work on such encroachments.
C. Place the removed encroachment neatly on the property ow.

3.04 PROJECT SIGNS

A. Refer to Section 01 58 13 - Project Signs.

3.05 TEMPORARY FACILITIES FOR ENGINEER

A. Provide temporary facilities as required on the Unit Price Schedule. Refer to Section 01 52 00 - Temporary Facilities for Engineer.

3.06 CONSTRUCTION SCHEDULES

A. Provide Construction Schedules as required for payment applications.
B. Refer to Section 01 32 13 - Construction Schedules.

3.07 BACKFILLING

A. Refer to Section 31 23 33 - Excavating and Backfilling.

3.08 DISPOSAL

A. Refer to Section 02 41 13 - Material Disposal.

3.09 RECORD DOCUMENTS

A. Provide Record Documents as required for payment applications. Refer

B. to Section 01 78 39 - Project Record Documents.

3.10 SURVEYING

A. Refer to Section 01 32 23 - Construction Surveying

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 02 08 02
Care and Control of Water

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION includes requirements for the care and control of ground and surface water.

1.02 MEASUREMENT AND PAYMENT

A. Where there is not a separate item listed on the Unit Price Schedule for work in this Section, no separate measurement and payment is made. Include cost for work under this Section in the related item listed on the Unit Price Schedule.
B. Measurement and payment is as noted on the Unit Price Schedule. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures. Where paid for separately, payment is in accordance with Section 01 29 20 - Schedule of Values.

1.03 SUBMITTALS

A. Submittals shall be as indicated in Section 01 33 00 - Submittal Procedures.
B. Submit a Plan to the Engineer prior to the start of construction or with bid, when required, where care and control of water is paid for separately. Plan shall include drawings and descriptions of how to implement the care and control of ground and surface water. Plan shall cover the protection of existing facilities and proposed work against normal flow, high flow and potential flooding conditions.
C. Control of water is paid for separately or when requested by the Engineer.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 GENERAL

A. Select the means, methods and techniques to control ground water and surface water.
B. Maintain the work reasonably free of water. Control shall be accomplished in a manner that will preserve the strength of the subgrade and backfill, not cause instability of slopes, will protect the proposed work and not result in damage to existing facilities or contamination of water. Lower the groundwater in advance of excavation utilizing wells, wellpoints or similar methods, as necessary. Open pumping with sumps and ditches is not permitted if it results in boils, loss of fines, softening of the ground or instability, or erosion of slopes. Install wells and wellpoints with suitable screens and filters so that continuous pumping of fines does not occur.
C. Arrange the discharge to facilitate collection of samples by the Engineer and to prevent erosion at the outfall. Remove care and control of water facilities in a manner as not to contaminate water and restore channel area to a condition satisfactory to the Engineer, after the work is complete.

3.02 REPAIR

A. Repair or replace damage caused by water at no cost to the Owner. Remediate contamination of water resulting from construction activities on the Project at no cost to the Owner.

END OF SECTION

SECTION 02 08 03
Trench Safety System

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION includes requirements for the installation and maintenance of a Trench Safety System.

1.02 MEASUREMENT AND PAYMENT

A. Measurement and payment is as noted on the Unit Price Schedule. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. Implement the Trench Safety System requirements of the Federal, State and local Safety and Health Regulations and the Occupational Safety and Health Administration (OSHA), 29 CFR, Part 1926 Subpart P - Excavation. Texas Health and Safety Code Ann., Chapter 756. Miscellaneous Hazardous Conditions. Subchapter C. Trench Safety § 756.023. Trench Excavation for Political Subdivision.

1.04 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures. Submit a safety plan specifically for the construction of trench excavation. Design the trench safety plan to be in accordance with OSHA regulations, referenced above, that govern the presence and activities of individuals working in and around trench excavations.

B. Construction and Shop Drawings containing deviations from OSHA regulations or special designs shall be sealed by a licensed Texas Professional Engineer retained and paid by the Contractor. Review of the safety plan or Trench Safety System by the Engineer will only be in regard to compliance with this Section and will not constitute approval by the Engineer or relieve the Contractor of obligations under State and Federal trench safety laws.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 NOT USED

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 02 41 00
DEMOLITION AND REMOVALS

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. The Contractor shall furnish all supervised labor, materials, equipment, and incidentals required for the removal of existing structures, equipment, piping and other improvements.

B. The Contractor shall furnish all supervised labor, materials, equipment, and incidentals required for the removal of any pavement, including base material, as shown on the construction plans.

Removal procedures are as outlined below:

1. Provide testing for lead-based paint and asbestos containing materials. Submit sampling results to Engineer and Owner prior to demolition.
2. Complete or partial removal and disposal of specified existing piping, mechanical equipment, electrical equipment and miscellaneous appurtenances encountered during construction operations.
3. Temporary modification of structures, equipment, appurtenances and utilities as necessary to allow for operation of the facilities during construction.
4. Demolition, partial removal and cutting of existing concrete structure as required for the new construction.
5. Handling of existing equipment to be reinstalled or salvageable as specified.
6. Off-site disposal of excess and unacceptable materials including but not limited to concrete, concrete blocks, and bricks. All materials to be disposed of in a legal manner.
7. This section may not cover all of the activities necessary to perform the work. The Contractor shall exercise due concern for the utility system operation and shall diligently direct all of the Contractor's activities toward maintaining continuous operation of the existing facilities and minimizing operation impacts.

1.02 CONDITION OF STRUCTURES:

A. The Owner and the Engineer assume no responsibility for the actual condition of the equipment to be modified.

B. By submitting a bid, the Contractor affirms that the Contractor has carefully examined the site and all conditions affecting the Work. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable.

1.03 RULES AND REGULATIONS:

A. The International Building Code shall control the demolition, modification or alteration of the existing equipment and structures.

B. No blasting shall be done on site.

1.04 SUBMITTALS:

A. Provide a detailed sequence of demolition and removal work as part of the Contractor's schedule.

1.05 ACCESS:

A. Conduct demolition and modification operations, and the removal of equipment and debris to ensure minimum interference with roads and walks both on-site and off-site and to ensure minimum interference with occupied or used facilities.

B. Special attention is directed towards maintaining safe and convenient access to the existing facilities by Owner's operations personnel and associated vehicles.

C. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Engineer. Provide alternate routes around closed or obstructed traffic in access ways.

1.06 PROTECTION:

A. The Contractor shall conduct construction activities to minimize damage to adjacent buildings, structures, utilities, storm drainage, and other facilities, including persons.

1.07 DAMAGE:

A. The Contractor shall immediately report damage caused to adjacent facilities by demolition or removal operations. The Contractor shall promptly make all required repairs as directed by the Engineer and at no cost to the Owner.

1.08 UTILITIES:

A. It shall be the Contractor's responsibility to maintain existing utilities in service and protect against damage during demolition operations.

1.09 POLLUTION CONTROL:

A. For pollution control, use sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust and dirt rising and scattering in the air to the lowest level of air pollution practical for the conditions of work. Comply with the governing regulations.

B. Clean adjacent structures and improvements of all dust, dirt, and debris caused by demolition operations. Return areas to conditions existing prior to the start of work.

1.10 ASBESTOS TESTING AND MATERIAL HANDLING:

A. Asbestos containing materials (ACM) may be located within the project limits. Special waste management procedures and health and safety requirements will be applicable when removal and/or disturbance of this pipe occurs.

B. Written notification to the Texas Commission on Environmental Quality (TCEQ) 10 days prior commencing with the removal of ACM is required. At each location shown in the plans and/or identified by the contractor to involve ACM, the contractor will be required to remove the necessary amount of ACM to make the connection without creating any friable material.

C. For AC Pipe (if present) the contractor shall remove whole sections of ac pipe and make the tie-in at the nearest joint. Contractor will only uncover 20-feet of ac pipe at any time. Cutting of ac pipe shall be minimized. The contractor shall remove any cut ac pipe and store it in a secure, engineer approved location for

eventual disposal by contractor. Prior to performing this work, the contractor shall notify the engineer and the owner of the utility of the work schedule 72 hours in advance of beginning the work.

D. When working with ACM, contractor will comply with occupational safety and health administration (OSHA) and national emissions standards for hazardous air pollutants (NESHAP) regulations, including but not limited to use of personal protective equipment, specialized training, accreditation, use of wet work procedures to cut and remove ac pipe, and handling and disposal of ac pipe and material including contaminated soil.

E. ACM will be abandoned by removal. All ACM removed will become the property of the contractor. The contractor will provide the owner with disposal receipts showing proper disposal at an authorized facility.

1.11 LEAD PAINT TESTING AND MATERIAL HANDLING:

F. Provide existing coating testing and waste testing for lead, chromium, and cadmium by an independent, approved testing laboratory at the CONTRACTOR's expense. The following tests shall be required.

G. The CONTRACTOR is responsible for testing the existing paint coating for lead, chromium, and cadmium content prior to beginning work.

H. If contaminated coatings are determined to be present, CONTRACTOR shall be responsible for any soil contamination resulting from the removal, storage, handling and disposal of hazardous materials from the site. As a requirement for final acceptance the CONTRACTOR shall provide written certification that no soil contamination has occurred as a result of the CONTRACTOR's operations. In the event of such contamination the CONTRACTOR shall submit to the Owner a plan for site remediation in accordance with all Federal, State and Local regulations to be enacted immediately upon approval by the Owner at the CONTRACTOR's expense.

I. Notify the Owner in writing 30 days prior to the start of any lead-based paint removal work. The CONTRACTOR shall be responsible for notifying all required government environmental agencies within the required time frame.

J. Protection of Existing Work to Remain: Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better. All dry abrasive blasting must comply with TCEQ's Permit by Rule (PBR). The PBR requires that the usage rates for dry abrasive cleaning activities not to exceed 150 tpy, 15 tons per month, and 1 ton per day. These activities must be conducted at least 500 feet from any "receptors". Records must be kept of the hours that cleaning operations are conducted, along with usage rates for abrasive materials.

K. Boundary Requirements: Provide physical boundaries around the lead control area by roping off the area to limit entry of unauthorized personnel.

L. Change Room and Shower Facilities: Provide clean change rooms within the physical boundary around the designated lead control area. Upon completion of

initial employee exposure assessment, adjust requirements in accordance with 29 CFR 1926.62.

M. Personnel Protection: Personnel shall wear and use protective clothing and equipment as specified herein. Provide eye protection for personnel engaged in lead-based paint removal operations. Eating, smoking, or drinking is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been given appropriate training and protective equipment.

N. Warning Signs and Labels: Provide and post warning signs at approaches to lead control areas and at each control area. Locate signs at such a distance that personnel and/or the public may read the sign before entering the control area and take the necessary protective action. Signs shall comply with the requirements of 29 CFR 1926.62.

O. Perform lead-based paint removal work in accordance with 29 CFR 1926.62 and as specified herein. Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing tobacco or chewing gum shall not be permitted in the control area. Sanitary conditions shall be maintained at all times by the CONTRACTOR. PERSONNEL ENGAGED IN THE REMOVAL OF LEAD-BASED PAINT SHALL NOT BE EXPOSED TO AIRBORNE CONCENTRATIONS OF LEAD-BASED PAINT IN EXCESS OF 30 MICROGRAMS PER CUBIC METER. The general public or personnel of other trades not engaged in the removal of lead-based paint shall not be exposed to airborne concentrations of lead-based paint in excess of 30 micrograms per cubic meter. No visible paint chips shall escape the lead control area. Removal of hazardous paint from the control area shall be the responsibility of the CONTRACTOR. No one will be permitted in the lead control area unless he/she is provided with appropriate training and protective equipment. Protect all surrounding surfaces, ground cover, and plant life within the lead control area marked by the physical boundary from lead contamination. Lead-based paint debris shall be captured and stored for disposal on a daily basis in accordance with applicable regulations.

P. Personnel Exiting Procedures: Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day.

a. Vacuum themselves off.
b. Remove protective clothing and place them in approved waste containers.
c. Use hand-washing facilities.
d. Shower (if required).
e. Change to clean clothes prior to leaving the physical boundary designed around the lead-contaminated job site.

Q. If required, monitoring of airborne concentrations of lead shall be in accordance with 29 CFR 1926.62 and as specified herein. Air monitoring, testing, and reporting shall be performed by a CIH (Certified Industrial Hygienist) or an Industrial Hygiene (IH) Technician.

a. The CIH or the IH Technician shall be on the job site to perform the monitoring.

b. Obtain personnel air monitoring samples from employees who are anticipated to have the greatest risk of exposure as determined by the CIH or IH. In addition, obtain a minimum of two (2) air monitoring samples outside the lead control area on a daily basis.

c. Monitoring Employees: If the employee exposure level exceeds 30 micrograms per cubic meter of air, lead abatement work shall be stopped. The CONTRACTOR shall take immediate corrective action to reduce exposure levels below 30 micrograms per cubic meter of air.

d. Submit results of air monitoring samples to the Owner within 3 days after the air samples are taken. Notify the Owner immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air.

R. Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. Perform housekeeping at the end of each shift and when the paint removal operation has been completed by cleaning the lead control area of visible lead-based paint chips using a HEPA-filtered vacuum.

S. Upon completion of work and prior to removal of the lead control area, the CONTRACTOR will notify the Owner for a final lead inspection. As a minimum, the final lead inspection shall include air, water, and soil samples for verification of contamination which may have occurred during the course of the project.

T. Testing of Lead-Containing Paint Residue: Test lead-containing paint residue in accordance with 40 CFR 261 for hazardous waste.

U. Waste disposal shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall collect, store, and remove the lead contaminated waste and lead-containing paint as follows:

a. Collect lead contaminated waste, scrap, debris, bags, containers, equipment, and lead contaminated clothing.

b. Store removed lead-based paint, lead contaminated clothing and equipment, dust, and debris into Department of Transportation approved container systems. Label each container to identify the waste and the date wastes were first put into the container.

c. Disposal must be at a site approved by the Environmental Protection Agency and the TCEQ to accept lead-based paint waste. Notify the Owner at least 14 days prior to removal of the containers to inspect the containers and the hazardous waste manifest. As necessary, make deliveries of lead-based paint wastes to ensure containers do not remain on the job site longer than 90 calendar days from the initial loading date affixed to the container.

d. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

V. Submit written evidence that the lead-based paint waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and state or local regulatory agencies. Submit one copy of the completed manifest, signed and dated by the initial transporter in accordance with 40 CFR 262.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 REMOVAL OF EXISTING EQUIPMENT, PIPING AND APPURTENANCES:

A. Subject to the constraints of maintaining the existing utilities in operation; existing equipment, valves, piping, and appurtenances not necessary for the operation of the new facility shall remain the property of the Owner unless otherwise directed by the Owner. The Contractor shall remove, clean, and prepare for storage all equipment to remain as directed by the Owner. If the Owner elects not to retain ownership of a certain item, the item shall become the property of the Contractor and shall be removed from the site at the Contractor's expense.

B. All equipment and materials to be stored for reinstallation or salvage shall be properly protected from damage.

C. Any items of equipment damaged or lost due to the Contractor's carelessness, mishandling, or faulty procedures and/or workmanship shall be repaired or replaced in kind to the satisfaction of the Engineer.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 02 41 13

SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Removal and disposal of:
      a. Steps
      b. Fence
      c. Guardrail
      d. Mailbox
      e. Riprap
      f. Stormwater Structure
      g. Retaining Walls Less Than 4 Feet
      h. Retaining Walls Greater Than 4 Feet

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

B. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

C. The price bid shall include:
   1) Removal of footings of all types and depths
   2) Removal of wall
   3) Removal of reinforcing
   4) Shoring wall construction and design (if needed)
   5) Loading
   6) Unloading
   7) Storing
   8) Hauling
   9) Salvaging or disposal
   10) Clean-up

1.3 REFERENCES

A. Abbreviations and Acronyms
   1. MUTCD – Manual on Uniform Traffic Control Devices

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sequencing
   1. Pedestrian Traffic
      a. Where existing sidewalks are to be closed during Paving Removal activities:
         1) Utilize pedestrian/sidewalk detour route specified in the Drawings

a) If no detour route is provided, submit a pedestrian/sidewalk detour route that has been signed and sealed by a registered professional engineer to City for review.

2) The pedestrian/sidewalk detour route will be subsidiary to pertinent Traffic Control items included with the project.

b. Install all sidewalk detours and closures in accordance with the TMUTCD, State, and local guidelines.

c. Provide any traffic control devices as required by the City. .

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Shop Drawings

1. Temporary Shoring Design
   a. Submit a temporary shoring design for review and approval prior to removal of retaining walls or any other removal activities requiring a shoring wall.
   b. The design of a shoring wall is considered subsidiary to the appropriate bid item.
   c. Provide a signed and sealed shoring wall design by an engineer licensed in the state of Texas for all shoring walls unless otherwise specified in the Drawings or directed by City.

B. Informational Submittal

1. Equipment Information
   a. Submittal for all major equipment to include:
      1) Equipment name
      2) Size
      3) Intended use

PART 2 - PRODUCTS [NOT USED]

2.1 NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation

1. Verify all removal limits prior to construction unless otherwise directed by the City.

3.2 SITE DEMOLITION

A. Disposal of materials

1. Accept ownership and dispose of all materials removed.
2. Dispose of all material in accordance with Federal, State, and local laws and regulations.

3. The disposal of any material removed as part of Selective Site Demolition is considered subsidiary to the applicable items.

B. Removal of Stairs
   1. Sawing
      a. Perform sawing activities for concrete paving and sidewalk in accordance with Section 02 41 15.
   2. Minimum Limits of Stair Removal
      a. If adjacent stairs are to remain, remove stair to the nearest whole stair. Do not saw cut an existing stair.
      b. If stairs to be removed are adjacent to a sidewalk, remove stairs to the nearest sidewalk joint.

C. Removal of Fence
   1. Remove all fence components above and below ground.
   2. Backfill holes with acceptable fill material.
   3. Compact per Drawings.
   4. Use caution in removing any fence material.
   5. Coordinate with property owners as needed to maintain a fenced area at all times especially when animals are kept within the fencing.
   6. Contractor is responsible for maintaining fencing and installing temporary fencing as needed during construction.
   7. Contractor is responsible for providing fencing at all times.
   8. Installing and removing temporary fencing when necessary is subsidiary to Removal of Fence.

D. Removal of Guardrail
   1. Remove rail elements in original lengths.
   2. Remove fittings from the posts and the metal rail prior to removing the posts. Once the fittings and metal railing is removed, remove the posts.
   3. Remove and replace any guardrail to remain that is damaged during construction activities at no cost to the City.
   4. Completely remove posts and any paving material surrounding the posts.
   5. Backfill any holes with acceptable fill material.

E. Removal of Mailbox
   1. Advance Coordination:
      a. Coordinate with property owner prior to removal of mailbox.
      b. Coordinate with local post office prior to removal. Provide approach and access space in accordance to post office requirements.
      c. Provide the City and the property owner with a written confirmation of the timeframe.
   2. For non-custom or decorative postal mailboxes, salvage existing materials for reuse when possible.
   3. For all custom and/or decorative mailboxes:
      a. Replace the custom mailbox with a standard post office approved mailbox. No custom mailboxes will be constructed unless specified in the Drawings or directed by the City.

b. If property owner wishes to remove or salvage a custom mailbox, determine an agreed upon timeframe with the City, the Contractor, and the property owner for removal.

4. The Contractor is responsible for providing a temporary mailbox during construction for any mailbox that is proposed to be removed and relocated, reinstalled, or replaced.
5. Maintain mailbox and/or mail delivery for duration of project. No separate pay will be provided.

F. Removal of Riprap
1. Remove concrete riprap to the nearest joint.
2. Conform to concrete sawing requirements in Section 02 41 15.

G. Removal of Stormwater Structure
1. Remove entire structure or to the nearest joint as specified in the Drawings.
2. Removal includes all components of the stormwater structure including footings, toe walls, and mitered RCP ends.
   a. In accordance with utility pipe removal requirements in Section 02 41 14.
   b. In accordance with concrete sawing requirements in Section 02 41 15.
3. Provide temporary erosion control protection for adjacent side slopes, drainage channels, and ditches. Temporary erosion control is considered subsidiary to the Removal of Stormwater Structures.
4. Repair or replace any portion of remaining structure that is damaged as a result of removal activities.
5. Do not use explosives to remove portions of the existing structure.
6. Do not use a demolition ball, other swinging weight, or impact equipment unless approved in writing by City.
7. Use pneumatic or hydraulic tools for final removal of concrete at the removal limits.
8. Use removal equipment that will not damage any remaining portion of the stormwater structure.

H. Removal of Retaining Wall Less Than 4 Feet
1. Any decorative or landscape retaining wall within the City's right-of-way will not be replaced unless required for grading purposes.
2. A retaining wall is required if the slope to tie back to existing ground within the City's right-of-way is steeper than 4:1.
3. If a retaining wall is required:
   a. Determine if a retaining wall is required before removing any decorative or landscape retaining walls.
   b. Request approval from City before removing decorative or landscape retaining wall.
4. If a retaining wall is not required:
   a. Remove any decorative or landscape retaining wall within the City's right-of-way and re-grade to a maximum of 4:1 slope.
   b. Do not replace the decorative or landscape retaining wall.
5. Remove wall to the nearest existing joint where possible. If not possible, obtain approval from the City for removal limits.
6. In accordance with concrete sawing requirements in Section 02 41 15.

7. Removal includes all components of the retaining wall.
8. Do not use explosives to remove portions of the existing structure.
9. Do not use a demolition ball, other swinging weight, or impact equipment unless approved in writing.
10. Use pneumatic or hydraulic tools for final removal of concrete at the removal limits.
11. Use removal equipment that will not damage any remaining portion of the retaining wall.
12. Construct an approved shoring wall when necessary to provide a safe environment for workers and the travelling public.

I. Removal of Retaining Wall Greater Than 4 Feet

1. Any decorative or landscape retaining wall within the City's right-of-way will not be replaced unless required for grading purposes.
2. A retaining wall is required if the slope to tie back to existing ground within the City's right-of-way is steeper than 4:1.
3. If a retaining wall is required:
   a. Determine if a retaining wall is required before removing any decorative or landscape retaining walls.
   b. Request approval from City before removing decorative or landscape retaining wall.
4. If a retaining wall is not required:
   a. Remove any decorative or landscape retaining wall within the City's right-of-way and re-grade to a maximum of 4:1 slope.
   b. Do not replace the decorative or landscape retaining wall.
5. Remove wall to the nearest existing joint.
6. In accordance with concrete sawing requirements in Section 02 41 15.
7. Removal includes all components of the retaining wall including footings.
8. Do not use explosives to remove portions of the existing structure.
9. Do not use a demolition ball, other swinging weight, or impact equipment unless approved in writing.
10. Use pneumatic or hydraulic tools for final removal of concrete at the removal limits.
11. Use removal equipment that will not damage any remaining portion of the retaining wall.
12. Construct an approved shoring wall when necessary to provide a safe environment for workers and the travelling public.

3.3 REPAIR

A. Repair the following at no cost to the City if any damage is caused due to Selective Site Demolition activities:

1. Adjacent concrete or asphalt pavement
2. Adjacent sidewalk
3. Adjacent curb or curb and gutter
4. Remaining portions of stormwater structures
5. Remaining portions of retaining walls
6. Subgrade or base material
7. Utility piping, structures, and appurtenances

8. Irrigation systems including but not limited to sprinkler heads, conduit, and pipe.
9. Landscape beds or planters
10. Decorative hardscape or landscape features

END OF SECTION

SECTION 02 41 13
Material Disposal

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for removal and proper disposal of unusable, objectionable or excess material.

1.02 MEASUREMENT AND PAYMENT

A. Where there is not a separate item listed on the Unit Price Schedule for work in this Section, no separate measurement and payment is made. Include cost for work under this Section in the related item listed on the Unit Price Schedule.
B. Measurement and payment is as noted on the Unit Price Schedule.
C. Refer to Section Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall be as indicated in Section 01 33 00 Submittal Procedures.
B. Submit prior to start of work:

1. For disposal of material required to be taken to a landfill submit:
2. Copy of TCEQ license
3. Owner project number and pay item number.
4. Flood Insurance Rate Map (FIRM) page with boundary of fill location identified.
5. Aerial map with boundary of fill location identified.
6. Physical address of the disposal location.
7. Estimated total number of cubic yards of excavated material to be disposed at the location.
8. For disposal of excavated material submit:
9. Fill permit, or demonstration of compliance with any local jurisdictional requirements for material disposal.
10. Disposal agreement signed by the property owner to include access for OWNER personnel to verify suitability of the site to receive fill.
11. OWNER project number and pay item number.
12. Flood Insurance Rate Map (FIRM) page with boundary of fill location identified.
13. Aerial map with boundary of fill location identified.
14. Physical address of the disposal location.
15. Estimated total number of cubic yards of excavated material to be disposed at the location.
16. For disposal or recycling of concrete rubble, pipe or debris submit:
17. OWNER project number and pay item number.
18. Physical address of disposal location.
19. Intended use of the material if not taken to a landfill or recycling facility.

20. Estimated total quantity of material to be disposed at the location.
21. For disposal of tires submit:
22. OWNER project number and pay item number.
23. Name and physical address of disposal or recycling location.
24. Estimated total quantity of material to be disposed at the location.
25. For burning of cleared vegetation submit:
26. OWNER project number and pay item number.
27. Material intended to be burned.
28. Intended location of burn pit.
29. Copy of TCEQ burn permit.
30. List of notified local agencies and contact phone numbers.
31. Demonstration of compliance with any local jurisdictional requirements for material disposal.

C. During construction, for material disposed in a landfill or at a recycling facility submit the following pay application support documents. At the direction of the Engineer provide one of the following;

1. One copy of the landfill operator's ticket or receipt clearly showing the truck load weight and/or cubic yards accepted by the landfill or recycling facility.
2. Summary including the amount of material and disposal location for all material removed from the site on a daily basis.
3. For disposal or recycling of concrete rubble, pipe or debris submit:
4. OWNER project number and pay item number.
5. Physical address of disposal location.
6. Intended use of the material if not taken to a landfill or recycling facility.
7. Estimated total quantity of material to be disposed at the location.
8. For disposal of tires submit:
9. OWNER project number and pay item number.
10. Name and physical address of disposal or recycling location.
11. Estimated total quantity of material to be disposed at the location.
12. For burning of cleared vegetation submit:
13. OWNER project number and pay item number.
14. Material intended to be burned.
15. Intended location of burn pit.
16. Copy of TCEQ burn permit.
17. List of notified local agencies and contact phone numbers.
18. Demonstration of compliance with any local jurisdictional requirements for material disposal.

D. During construction, for material disposed in a landfill or at a recycling facility submit the following pay application support documents. At the direction of the Engineer provide one of the following;

E. One copy of the landfill operator's ticket or receipt clearly showing the truck load weight and/or cubic yards accepted by the landfill or recycling facility.
F. Summary including the amount of material and disposal location for all material removed from the site on a daily basis.

PART 2 - PRODUCTS Not used

PART 3 - EXECUTION

3.01 GENERAL

A. Remove unusable, objectionable or excess material from the construction work area and properly dispose of such material.
B. Disposal of material in wetlands or other environmentally sensitive areas without permits is prohibited.
C. Disposal of material in the base flood elevation (BFE) or the 500-year flood plain as determined by the latest FEMA approved FIRM maps is prohibited. If a disposal site is rejected on these grounds, the Contractor, at their discretion, can submit a variance request with an explanation why the disposal of material is not considered fill in the flood plain. The Engineer will consider the request and respond accordingly. The decision of the Engineer shall be final.
D. Material disposed of without permits shall be removed and properly disposed of at no cost to the Owner. Restore the site at no cost to the Owner.
E. Cleared and grubbed material may be burned on the right-of-way, provided the following items are adhered to:

    1. Obtain permits required for burning including, but not limited to, permit(s) authorizing operation of the trench burner.
    2. Notify appropriate State and local governmental agencies and adhere to the requirements of these agencies.
    3. Obtain approval for location of the burn pit from the appropriate government agency and the Engineer.
    4. Perform burning with a permitted trench burner.
    5. Constantly supervise burning until extinguished. When burning is complete, remove ash, stumps and other objectionable material from the pit and dispose of in accordance with this Section.
    6. Backfill burn pit in accordance with Section 31 23 33 Excavating and Backfilling.

F. Cleared and grubbed material may be chipped on-site and chips disposed of in areas approved by the Engineer, under the following conditions:

    1. Scatter chips evenly on berm or slopes in a thickness not to exceed 3 inches to prevent killing turfgrass or other desirable vegetation.
    2. Dispose of excess chips in accordance with this Section.
    3. Avoid discharge of chipped material into waterways.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 02 41 15

PAVING REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction methods for
   a. Remove Concrete Pavement
   b. Remove Concrete Curb and Gutter
   c. Remove Concrete Valley Gutter
   d. Remove Sidewalk
   e. Remove Curb Ramp
   f. Remove Asphalt Pavement
   g. Remove Driveway
   h. Remove Brick Pavers
   i. Remove Permeable Pavers
   j. Wedge Milling
   k. Surface Milling
   l. Butt Joint Milling
   m. Pavement Pulverization
   n. Obliterate Abandoned Road
   o. Pavement Removal for Utility Trenching

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.3 REFERENCES

A. Abbreviations

1. HMA – Hot-mix Asphalt

B. Reference Standards

1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
2. Texas Manual on Uniform Traffic Control Devices (TMUTCD).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sequencing

1. Sidewalk Construction
   a. Where existing sidewalks are to be closed during Paving Removal activities:

1) Utilize pedestrian/sidewalk detour route specified in the Drawings
   a) If no detour route is provided, submit a pedestrian/sidewalk detour route that has been signed and sealed by a registered professional engineer to the City for review.

b. The pedestrian/sidewalk detour route will be subsidiary to pertinent Traffic Control items included with the project.
c. Install all sidewalk detours and closures in accordance with the TMUTCD, State, and local guidelines.
d. Provide any traffic control devices as required by the City.

2. Pavement Removal
   a. Install traffic control devices prior to removal of pavement per the Drawings.
   b. If no traffic control plan is provided, submit a traffic control plan that has been signed and sealed by a registered professional engineer to the City for review.

B. Pre-Construction Meeting

1. Hold a pre-construction meeting prior to performing any tasks included under Paving Removal. Invite the City and appropriate representatives. The following items will be reviewed and discussed at the meeting:
   a. All removal limits for any pavement to be removed
   b. Concrete paving removal method

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Informational Submittal:

1. Equipment Information
   a. Submittal for all major equipment to include:
      1) Equipment name
      2) Size
      3) Intended use

PART 2 - PRODUCTS [NOT USED]

2.1 [NOT USED]

PART 3 - EXECUTION

3.1 PREPARATION

A. Site Preparation

1. Mark all pavement removal limits prior to construction.
2. City will review and provide direction to Contractor, regarding proposed limits prior to saw cutting, milling, or any other pavement removal activities.

3. For maintenance projects, the City will mark the limits of Paving Removal prior to construction.

3.2 PAVEMENT REMOVAL

A. Sawing

1. Full-depth saw cut all pavement to be removed.
2. Make a clean, smooth cut producing a groove 1/8 inch to 1/4 inch wide and full depth.
3. Any saw cut wider than 1/4 inch will not be accepted.
4. Re-saw pavement edge after pavement is removed as many times as necessary to provide a smooth, neat, straight pavement edge free from chips or gouges. Contractor to re-saw a minimum of one time.
5. If a saw cut falls within 5 feet of an existing joint, pavement edge, or edge of gutter, remove paving to the nearest joint, pavement edge, or gutter edge.
6. Minimize dust and residue from entering the atmosphere by using water, vacuums, or other approved dust reducing measures.
7. Utilize erosion control measures to prevent dust and residue from entering the storm drain system in accordance with Section 31 25 14.
8. Use care to prevent fracturing or spalling of adjacent existing pavement. Repair any damage done to the existing pavement due to saw cutting or pavement removal in accordance with Sections 32 01 17 or 32 01 29 at no cost to the City.

B. Remove Concrete Paving

1. Saw Cut
   a. In accordance with this Section.
2. Minimum Limits of Removal
   a. Parallel to the Centerline
      1) Minimum cut along street path is:
         a) 10 feet in total length
         b) 1 foot from the edge of the trench
   b. Perpendicular to the Center Line
      1) Remove full panel of each lane width if trench or repairs are contained within the lane and panel. If trench or repairs are contained within a half panel (beginning at an existing joint), then half panel replacement is allowed.
      2) For locations where two or more lanes are affected, remove the full width of affected lanes.
      3) Maintain minimum gutter width of 2 feet from back of curb at all times.
   c. Concrete alley or residential street less than 30 feet wide:
      a) Remove pavement from centerline to back of curb. Curb will be considered subsidiary to removal of pavement.
   d. Concrete alley or residential street greater than 30 feet wide:
      a) Maintain a minimum of 10 feet from center line or gutter to trench edge or repair.
      b) Remove pavement starting at the centerline if trench edge or repair is less than 10 feet from centerline.

c) If the trench edge or repair is within 10 feet of the back of curb, remove pavement from trench edge or repair to back of curb. Curb will be considered subsidiary to removal of pavement.

3. Construction
   a. A drop hammer or guillotine-style concrete breaker is not allowed without prior approval by City.
   b. Pavement removal method to be discussed and approved by City during the Pre-removal Meeting.
   c. Preferred method:
      1) Saw cut sections of the concrete pavement.
      2) Vertically lift concrete pavement section in whole pieces in a way that does not damage existing features.
   d. If pavement can't be removed utilizing the preferred method, utilize a jackhammer to break-up concrete and remove using a front-end loader or backhoe.

C. Remove Concrete Curb and Gutter

1. Saw Cut
   a. In accordance with this Section
2. Minimum Limits of Removal
   a. Minimum width of 2 feet from back of curb.
   b. Minimum length of 5 feet.
   c. If new joint is within 5 feet of existing joint, remove to existing joint limits.

D. Remove Sidewalk and Curb Ramp

1. Saw Cut
   a. In accordance with Sawing
2. Minimum Limits of Sidewalk Removal
   a. Minimum sidewalk removal of one full panel.
   b. Sidewalk replacement shall comply with ADA criteria.
   c. Remove curb ramp to the nearest joint. Do not saw cut and leave in place any portion of the existing curb ramp unless specified in the Drawings.

E. Remove Asphalt Paving

1. Saw Cut
   a. In accordance with this Section
   b. Protect asphalt edges to prevent spalling or damage.
   c. If damage or spalling occurs, obtain direction from the City for repairs, if necessary.
2. Minimum Limits of Removal
   a. Parallel to the Centerline
      1) Minimum cut along the street path is:
         a) 10 feet in total length.
         b) 1 foot from the edge of the trench if the trench width is wider than 5 feet.
   b. Perpendicular to the Center Line – Multiple Lanes
      1) If the trench or repairs occur between the center line and the inside lane line, remove the full lane width.
      2) If the trench or repairs occur between the gutter edge and the outside lane, remove from the lane line to the gutter edge.

3) If the trench or repairs occur between two lanes, remove half-lane-width to half-lane-width.

c. Perpendicular to the Center Line – Single Lane
   1) General:
      a) 2 feet from the edge of the trench
      b) Minimum width from repair to gutter edge is 10 feet.
      c) Remove pavement to gutter edge if distance from trench or repair to gutter edge is less than 10 feet
   2) Concrete alley or residential street less than 30 feet wide:
      a) Remove pavement from centerline to gutter edge.
   3) Concrete alley or residential street greater than 30 feet wide:
      a) Maintain a minimum of 10 feet from center line or gutter edge to trench edge or repair.
      b) Remove pavement starting at the center line if trench edge or repair is less than 10 feet from centerline.
      c) Remove pavement from trench edge or repair to gutter if distance from trench edge or repair to the face of curb is less than 10 feet.

3. Construction
   a. Utilize a milling machine to remove pavement where possible in accordance with this Section.
   b. Obtain approval prior to construction to utilize alternative equipment for asphalt pavement removal.

F. Remove Driveway
   1. Saw Cut
      a. In accordance with this Section
   2. Minimum Limits of Removal
      a. If the driveway is concrete, remove to nearest driveway joint.

G. Remove Brick Pavers and Permeable Pavers
   1. Saw Cut
      a. In accordance with Sawing
      b. Saw cut 2 feet beyond the limits of the pavers if the adjacent pavement is concrete or asphalt.
   2. Remove pavers to the limits specified in the Drawings.
   3. If salvaging pavers for re-use, remove, palletize and either deliver to specified location in Drawings or stockpile for re-use on the Project.

H. Milling
   1. General
      a. Mill surfaces to the depth specified in the Drawings.
      b. Milled surface should be rough. If necessary, grind or mill the surface again to make the surface rough.
      c. If the milled surface is going to be opened to traffic:
         1) Install a temporary transition section.
         2) An acceptable transition is 2 inches over 5 feet.

3) A different transition may be approved by City prior to opening the milled surface to traffic.

d. Remove excess material and clean milled surfaces
e. Stockpiling of milled material will not be permitted within the right of way unless otherwise approved by City.

2. Milling Equipment
   a. Provide equipment that meets the following criteria.
      1) Power operated milling machine capable of removing the specified pavement thickness in maximum of two passes
      2) Self-propelled with sufficient power, traction, and stability to maintain accurate depth of cut and slope
      3) Able to immediately remove material cut from the surface of the roadway and discharge the cuttings into a truck utilizing an integral loading and reclaiming system
      4) Equipped with a dust control system
      5) Equipped with a manual system that provides uniform varying depths of cut while the machine is in motion.
3. Wedge and Surface Milling
   a. Only used for roadway maintenance. Only utilized with prior approval by City or as specified in Drawings.
   b. Wedge Mill existing asphalt or concrete from the gutter edge at a minimum depth of 2 inches and transition to match the existing pavement within a 5 foot width.
   c. Surface Mill existing asphalt to the depth specified on Drawings.
   d. Provide a uniform milled surface free from gouges, ridges, oil film, and other irregularities.
   e. Wedge milling includes the portion of HMA pavement that covers the existing concrete curb and gutter. This depth is estimated to vary from 2 inches to the full height of the curb. This additional depth would be milled prior to milling the minimum 2 inches previously specified.
   f. Perform wedge or surface milling operations in a continuous manner for the length specified in the Drawings.
4. Butt Joint Milling
   a. Butt joint will be full width of overlay operation
   b. Typical locations for butt joints are at the beginning and ending of streets where asphalt paving is removed or where a street is being overlaid. Butt joints may be required in other locations as specified in the Drawings.
   c. Butt joints at a minimum of 20 feet wide (perpendicular to the center line) for the width specified in the Drawings.
   d. Taper the butt joint from 2 inches to 0 inches adjacent to existing pavement at the start or end of the project limits or as specified in the Drawings.
   e. Provide a temporary asphalt transition in accordance with this Section.

I. Pavement Pulverization
   1. Pulverization
      a. Pulverize the existing pavement to a depth of 8 inches. In accordance with Section 32 11 33.
      b. Temporarily remove and stockpile pulverized material.

c. After temporary removal, cut subgrade or base material down 2 inches.

2. Cement Application
   a. Use 3.5 percent Portland cement
   b. In accordance with Section 32 11 33.
3. Mixing
   a. In accordance with Section 32 11 33
4. Compaction
   a. In accordance with Section 32 11 33
5. Finishing
   a. In accordance with Section 32 11 33
6. Curing
   a. In accordance with Section 32 11 33
7. If the existing pavement has a combination of 10 inches of HMA pavement and crushed stone or gravel
   a. 2 inch cutting is not required
   b. Pulverize existing pavement 2 inches deep
   c. Temporarily remove and stockpile pulverized material

J. Obliterating Abandoned Roadway
   1. Strip and windrow existing topsoil before shaping operations
   2. Remove asphalt or concrete pavement in accordance with this Section.
   3. Remove any abandoned structures within the roadway unless otherwise specified in the Drawings.
   4. Scarify and mix the abandoned roadbed with soil and blade to produce a smooth, uniform appearance.
   5. Fill, cut, and shape the abandoned road to blend into the surrounding terrain.
   6. Grade to maintain drainage patterns.
   7. Eliminate or re-align existing ditches as appropriate to maintain positive drainage.
   8. Cover disturbed areas with topsoil after shaping operations.
   9. Install sod or hydro-mulching within the limits of disturbance after topsoil is installed.

K. Disposal, Salvaging, and Recycling Removed Pavement
   1. Contractor is responsible for any material removed during Paving Removal activities.
   2. Dispose of all material in accordance with Federal, State, and local laws and regulations.
   3. The disposal, salvaging, and recycling of any material removed as part of Paving Removal is considered subsidiary to the applicable items.
   4. Contractor is encouraged, but not required, to salvage and recycle as much material as possible. Any recycled material used on a City project shall be in accordance with the requirements of the appropriate Section based on the intended use.

3.3 REPAIR

A. Repair the following items to remain if any damage is caused due to pavement removal activities at no cost to the City:

1. Adjacent concrete or asphalt pavement
2. Adjacent sidewalk
3. Adjacent curb or curb and gutter
4. Subgrade or base material
5. Utility piping, structures, and appurtenances
6. Irrigation systems including but not limited to sprinkler heads, conduit, and pipe
7. Landscape beds or planters
8. Sod
9. Decorative hardscape or landscape features
10. Retaining walls

END OF SECTION

SECTION 02 91 00
Seeding

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General Conditions, Special Provisions, and Division-1 Specification sections, apply to work of this section. All disturbed area shall have fine grading, erosion control, and seeding in accordance with this section.

1.02 DESCRIPTION OF WORK INCLUDED IN THIS SECTION:

A. Fine Grading
B. Soil Preparation
C. Seeding
D. Mulches
E. Maintenance
F. Warranty

1.03 QUALITY ASSURANCE:

A. Contractor to follow standards set forth in the following references:
1. American Standard for Nursery Stock published by American Association of Nurserymen; October 27, 1980, Edition.
2. American Joint Committee on Horticultural Nomenclature; 1942 Edition of Standardized Plant Names.

1.04 SUBMITTALS:

A. Contractor shall submit for inspection the following items:
1. Receipts for all fertilizer and grass seed.
2. Submittals for all hydromulch additives, as well as fertilizers, tackifiers, and mulch materials.
3. Erosion Control Net and manufacturer's installation recommendations.

1.05 MEASUREMENT AND PAMENT:

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.06 WARRANTY:

B. Provide a uniform stand of grass by watering, mowing, and maintaining lawn areas until final acceptance. Re-seed seeded areas which fail to provide a uniform stand of grass, re-seed with specified materials until all affected areas are accepted by the Owner.

PART 2 PRODUCTS

2.01 FERTILIZER:

A. Fertilizer shall be uniform and 100% organic in composition, free-flowing, pelleted, and suitable for application with approved equipment. Fertilizer shall be GreenSense (6·2·4) or approved equal.

2.02 SEED:

A. Lawn Seed: Fresh, clean and new crop seed mixture.
1. Provide fresh, clean, new crop hulled seed tested to minimum percentages of

purity and germination as established by Official Seed Analysts of North America. Provide seed of grass species, proportions and maximum percentages of purity, germination and be free of: Poa Annua, bent grass, and noxious weed seed.

a. Bermuda Grass Seed in accordance with NCTCOG Specification Section 2.15.1.b.

Rate: 2 pounds per 1,000 square feet.

2.03 MULCH:

A. Hydromulch: Per industry standards.

2.04 WATER:

A. Free of substance harmful to plant growth. Hoses, pumps, sprinklers or other methods of transportation furnished by contractor.

2.05 TOPSOIL:

A. General Topsoil:

1. Furnish from stockpiled on-site material. If an insufficient quantity exists, furnish from offsite sources in quantities sufficient to complete the requirements as specified.
2. Natural, friable, fertile soil, characteristic of productive soil on-site, reasonably free of stones, clay lumps, roots and other foreign matter.
3. Proposed topsoil material shall be subject to approval by the Owner.

2.06 EROSION CONTROL NET:

A. Erosion control net shall be North American Green SC150BN, or approved equal.

PART 3 EXECUTION

3.02 FINISH GRADING:

A. The Contractor shall spread the topsoil and shall inspect the site to assure that grades are within 0.15 feet of finish grade prior to initiating work.

B. Finished Grades: Shall be understood to be final spot grades and contours indicated on the contract drawings. Where final spot grades or new contours are not indicated, finished grades shall be uniformly level or sloping between points for which elevations are given or contours are shown.

C. Tops and Bottoms of All Slopes: Round tops and bottoms of slopes and drainage swales. Adjust and warp slopes, at intersections of cuts and fills, to flow into each other or into the existing natural ground surface without noticeable break. Cuts and fills shall have a maximum slope of 3' horizontally to 1' vertically, unless otherwise shown on the contract drawings. The finished surface of all lawn areas after planting shall not be less than 1/4" below or more than 3/4" below the finished grade of all walks or other surface areas.

D. Fine Grading Areas: Bring the grade of areas to receive turf to a uniform, level slope, as determined by the use of surveying instruments, by discing, harrowing and other methods approved by the Owner. When establishing finish grades, remove and dispose of all clods, hard lumps, rocks, roots, litter and other foreign matter not passing through the teeth of a hand iron rake. Tractor drawn raking equipment that compacts lawn areas will not be allowed. Where lawns are intended to drain across pavements, the uphill grade shall be flush with the pavement; the downhill grade shall be 1/2" to 3/4" below the pavement

grade.

E. Settlement: Maintain ground surfaces to the finish grades shown on the contract drawings, and deposit whatever additional topsoil that may be required to correct any settlement or erosion that occurs prior to the date of issuance of the Certificate of Final Acceptance. The surface upon which additional topsoil is to be deposited shall be raked or otherwise satisfactorily prepared to ensure a proper bond. Fill hollows that develop from settling, to the finished elevations, with approved topsoil. Finished lawn areas shall be left sufficiently high to meet all paved areas and catch basins after settlement.

3.03 EROSION CONTROL NET

A. Install erosion control net per manufacturer's recommendations.

3.04 SEEDING:

A. Seeding Limits: As indicated on the drawings.

B. Responsibility: The contractor shall utilize all such measures as may be necessary, including, but not limited to, protective fencing, sod, or erosion control netting to produce a finished continuous blanket of turf over all areas designated to receive turf.

C. Fertilizer: No fertilizer shall be applied prior to seeding.

D. Seeding Operations:

1. Dry Seeding
    a. Seed immediately after preparation of bed. Spring seeding between March 1 and June 1, and Fall seeding between August 15 and October 15, or at such other times acceptable to the Owner.
    b. Seed indicated areas, within contract limits and areas adjoining contract limits, disturbed as a result of construction operations.
    c. Perform seeding operations when the soil is dry and when winds do not exceed 5 miles per hour velocity.
    d. Apply seed evenly by sowing equal quantities in two directions, at right angles to each other.
    e. Sow grass seed at specified rate.
    f. After seeding, lightly rake or drag surface of soil to incorporate seed into top 1/8" of soil. Roll with light lawn roller.

E. Mulching of Lawn Areas:

1. Apply hydromulch on seeded areas within 24 hours after seeding.
2. Place hydromulch uniformly, in a continuous blanket, per industry standards.
3. Protect buildings, paving, plantings and all non-seeded areas from hydromulch over-spray.

3.05 LAWN AND MAINTENANCE:

A. Maintain seeded areas for a period of at least 60 days after completion and acceptance of seeding operations.

B. Maintain seeded lawn areas, including watering, spot weeding, mowing, applications of herbicides, fungicides, insecticides and reseeding until a full, uniform stand of grass free of weeds, undesirable grass species, disease and insects is achieved and accepted by the Owner.

C. Water daily to maintain adequate surface soil moisture for proper seed germination.

Continue daily watering for not less than 30 days. Thereafter, apply 1/2" of water twice weekly until acceptance.

D. Repair, rework, and re-seed all areas that are washed out, eroded, or do not catch.
E. Fertilize with organic fertilizer after germination, but prior to first mowing.
F. Mow lawn areas as soon as lawn top growth exceeds a 3" height. Cut back to 2 1/2" in height. Repeat mowing as required to maintain specified height.

3.06 FINAL ACCEPTANCE:

A. Inspection to determine final acceptance of seeded lawns will be made by the City upon contractor's request. Provide notification at least 10 working days before requested inspection date.
   1. Seeded areas will be acceptable provided all requirements, including maintenance, have been completed and a healthy, uniform, close stand of the specified grass is established, free of weeds, undesirable grass species, disease and insects.
   2. In areas requested to be inspected, no individual lawn areas shall have bare spots or unacceptable cover totaling more than 2% of the individual areas.
B. Upon final acceptance of the seeding operations and completion of the maintenance period, the Owner will assume lawn maintenance.

END OF SECTION

SECTION 03 01 30

REPAIR AND REHABILITATION OF CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to repair or rehabilitate, as required, all existing concrete shown or indicated in the Contract Documents as being repaired or rehabilitated.

2. CONTRACTOR shall repair all damage to new concrete construction as specified in this Section except for repair Work specified in Section 03 30 00, Cast-In-Place Concrete.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the Work that must be installed with or before repair and rehabilitation of concrete.

C. Related Sections:

1. Section 03 15 00, Concrete Accessories.

2. Section 03 30 00, Cast-In-Place Concrete.

3. Section 03 60 00, Grouting.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).

2. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

3. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.

4. ASTM D3574, Test Methods for Flexible Cellular Materials – Slab, Bonded, and Molded Urethane Foams.

5. ASTM G109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.

6. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.03 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data: Information on all products proposed for use, including manufacturer's brochures, technical data, specifications, and other applicable data.

B. Informational Submittals: Submit the following:

1. Certificates: Certificates documenting that repair materials that will be in contact with potable water or water that will be treated to become potable are listed in NSF/ANSI 61.

2. Manufacturer's Instructions: Manufacturer's recommended procedures for installing materials proposed for use.

3. Special Procedure Submittals: When requested by ENGINEER, submit information on methods for supporting during demolition and repair Work existing structures, pipes, and other existing facilities affected by the Work.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling of Materials:

1. Conform to Section 01 65 00, Product Delivery Requirements, and this Section.

2. Clearly mark on containers manufacturer's name and label, name or title of material, manufacturer's stock number, and date of manufacture.

3. Handle materials carefully to prevent inclusion of foreign matter.

4. Do not open containers or mix components until necessary preparatory Work has been completed and application Work is to start immediately.

B. Storage of Materials:

1. Conform to Section 01 66 00, Product Storage and Handling Requirements, and this Section.

2. Store only approved materials at the Site.

PART 2 PRODUCTS

2.01 SYSTEM REQUIRMENTS

A. All repair and rehabilitation materials that can or will come into contact with potable water or that will be treated to become potable shall be listed in ANSI/NSF 61.

2.02 REPAIR MORTAR

A. Product Description: Repair mortar shall be prepackaged, cement-based product specifically formulated for repairing concrete surface defects.

B. Products and Manufacturers: Provide one of the following:

1. SikaTop 122 Plus, SikaTop 123 Plus, or SikaTop 126 Plus, by Sika Corporation.

2. DuralTop Gel, DuralTop Flowable Mortar by Euclid Chemical Company.

3. Or equal.

C. Materials:

1. Provide a two-component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar. Repair mortar shall be enhanced with penetrating corrosion inhibitor, and shall have the following properties:

Physical Property	Value	ASTM Standard
Minimum Compressive Strength at One Day	2,000 psi	C109
Minimum Compressive Strength at 28 Days	6,000 psi	C109
Minimum Bond Strength at 28 Days	1,800 psi	C882*
* Modified for use with repair mortars.		

2. Where the least dimension of the placement in width or thickness exceeds four inches, extend repair mortar by adding aggregate as recommended by repair mortar manufacturer.

3. Product shall be listed in NSF/ANSI 61.

2.03 EXPANSION JOINT REPAIR SYSTEM

A. System Description: Joint repair system shall consist of two components: an epoxy resin adhesive and hypalon sheeting.

B. Products and Manufacturers: Provide one of the following:

1. Sikadur Combiflex, by Sika Corporation.

2. Or equal.

C. Materials:

1. Epoxy Resin Adhesive: Provide two-component epoxy resin as follows:

a. Component “A” shall be modified epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents and pigments. Resin shall not contain butyl glycidyl ether.

b. Component “B” shall be primarily a reaction product of selected amine blend with epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents, pigments, and accelerators.

2. Hypalon Sheeting:

a. Provide sheeting of hypalon rubber, perforated along bonding edge to provide mechanical key. Sheeting shall have ability to be vulcanized with hydrocarbon solvent for adhesion to an epoxy resin adhesive.

b. Provide sheeting in 12-inch width with thickness of 40 mils.

c. Sheeting shall be able to be lapped or seamed by heat or by anaromatic hydrosolvent strip.

d. Provide sheeting with removable center expansion strip.

3. Products shall be listed in NSF/ANSI 61.

2.04 REPAIR OF EXPOSED REINFORCING STEEL

A. System Description: System for repair of exposed reinforcing steel shall consist of two components: an initial application of corrosion inhibitor and subsequent application of protective slurry mortar.

B. Corrosion Inhibitor:

1. Corrosion inhibitor shall penetrate the hardened concrete surface and form a protective layer on reinforcing steel.

2. Products and Manufacturers: Provide one of the following:

a. Sika FerroGard 903, by Sika Corporation.

b. Or equal.

3. Corrosion inhibitor shall:

a. Not change the substrate’s color, appearance, or texture.

b. Penetrate independently of orientation (horizontal, vertical, overhead) at rate up to 1/10 to 4/5 inches per day, depending on density of concrete, measured using secondary neutron mass spectroscopy.

c. Form on reinforcing steel a protective layer of high integrity of at least 100 angstroms thickness, measured using x-ray photon spectroscopy and secondary ion mass spectroscopy.

d. Demonstrate reduction in corrosion currents after treatment as determined using cracked beam corrosion tests of concrete, as adapted from ASTM G109.

e. Be capable of reducing active corrosion rates by at least 65 percent. Reduction shall be demonstrated by project references and an independent corrosion engineer using linear polarization resistance.

f. Penetrate up to three inches in 28 days, measured using secondary neutron mass spectroscopy.

g. Product shall be listed in NSF/ANSI 61.

C. Protective Slurry Mortar:

1. Material shall be two-component, polymer-modified, cementious waterproofing and protective slurry mortar. Provide two coats at coverage of 50 square feet per gallon per coat.

2. Products and Manufacturers: Provide one of the following:

a. Sikatop Seal 107, by Sika Corporation.

b. Or equal.

3. Product shall be listed in NSF/ANSI 61.

2.05 CRACK INJECTION MATERIALS

A. Structural Crack Repair System:

1. Epoxy for injection shall be low-viscosity, high-modulus moisture insensitive type.

2. Products and Manufacturers: Provide one of the following:

a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, by Sika Corporation.

b. Eucopoxy Injection Resin, by Euclid Chemical Company.

c. Or equal.

3. Product shall be listed in NSF/ANSI 61.

B. Non-structural Crack Repair System:

1. Hydrophobic Polyurethane Chemical Grout:

a. Provide hydrophobic polyurethane that forms a flexible gasket.

b. Products and Manufacturers: Provide one of the following:

1) SikaFix HH LV, by Sika Chemical Company.

2) Or equal.

c. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.

d. Minimum elongation of 250 percent in accordance with ASTM D3574.

e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.

f. Product shall be listed in NSF/ANSI 61.

2. Hydrophilic Acrylate-Ester Resin:

a. Hydrophilic crack repair system shall be acrylate-ester resin that forms a flexible gasket and increase in volume by at least 50 percent when in contact with water.

b. Products and Manufacturers: Provide one of the following:

1) Duroseal Multigel 850, manufactured by BBZ USA, Inc.

2) Or equal.

c. Product shall be listed in NSF/ANSI 61.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which the repair Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation:

1. Initial Surface Preparation: Remove by chipping, abrasive blasting, or hydro blasting all laitance, foreign material, and unsound concrete from entire area to be repaired. Further roughen surface as specified in this Section. Where non-shrink grout or repair mortar is used, perform additional surface preparation, if any, recommended by product manufacturer.

2. Wetting Procedure: Where repair concrete, shotcrete, or cement grout is used, and bonding agent is not required, or where repair mortar or non-shrink grout manufacturer recommends wet or saturated surface, perform the following:

a. Continuously apply water for at least four hours to surface being repaired. Where large surface areas are to be repaired, use fog-spray nozzles, mounted on stands, in sufficient number so that entire surface to be repaired is contacted by fog spray cloud.

b. Prevent concrete from drying until after repair is completed. Re-wet surfaces not yet repaired using water sprays at least a daily; should more than four days elapse without re-wetting surfaces not yet repaired, repeat the original saturating procedure.

c. Remove standing water in areas to be repaired before placing repair material. Provide means to remove excess water from structure.

3. Preparation for Epoxy Bonding Agent: Where repair material manufacturer recommends use of epoxy-bonding agent, conform to recommendations of both repair material manufacturer and bonding agent manufacturer.

3.03 INSTALLATION, GENERAL

A. Construction Tolerances: Shall be as specified in Section 03 30 00, Cast-In-Place Concrete, except as specified in this Section and elsewhere in the Contract Documents.

B. Care shall be taken to fully consolidate repair material, completely filling all portions of space to be filled.

C. Bring surface being repaired into alignment with adjacent surfaces, providing uniform, even surface. Surface repaired shall match adjacent existing surfaces in texture and shall receive coatings or surface treatments, if any, provided for the existing surface adjacent to repaired surface.

D. Curing:

1. Curing of repair mortar and non-shrink grout shall be in accordance with manufacturer's recommendations, except that minimum cure period shall be three days.

2. Curing of other materials shall be in accordance with requirements of Section 03 30 00, Cast-In-Place Concrete.

3.04 REPAIR OF SURFACE DEFECTS

A. Surface defects are depressions in a concrete surface that do not extend all the way through the concrete. Surface defects can result from removal of an embedded item, removal of an intersecting concrete member, physical damage, or unrepaired rock pockets created during original placement. For spalls that result from corroded reinforcing steel or other embedment refer to Article 3.07 of this Section.

B. Preparation: Perform the following in addition to requirements of Article 3.02 of this Section:

1. Remove by chipping all loose, damaged concrete to sound material.

2. Where existing reinforcing is exposed, remove concrete to minimum of one-inch around exposed bars. If existing bars are cut through, cracked, or cross sectional area is reduced by more than 25 percent from original, immediately notify ENGINEER.

3. Score-cut perimeter of area to be repaired to minimum depth of 1/2-inch and maximum depth that will not cut existing reinforcing steel. Chip out existing concrete to the score line so that minimum thickness of repair mortar will be 1/2-inch.

C. Repair Material:

1. Completely fill the surface defect with specified repair material, in accordance with material manufacturer's instructions and the Contract Documents.

2. Perform, with repair mortar, repairs of surface defects in concrete normally in contact with water or soil, and interior surfaces of structures that contain water.

3. Repair of other surface defects may be by applying repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.05 PATCHING OF HOLES IN CONCRETE

A. For holes larger than 12-inch diameter or equivalent area of hole, refer to the Drawings for reinforcing details.

B. Fill openings less than four inches in their least dimension with Class III non-shrink epoxy grout in accordance with Section 03 60 00, Grouting.

C. Openings greater than four inches and less than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class I non-shrink grout in accordance with Section 03 60 00, Grouting.

D. Openings greater than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class A concrete in accordance with Section 03 30 00, Cast-In-Place Concrete.

E. Where repaired holes are in contact with water or soil, provide hydrophilic rubber waterstop within the opening in accordance with Section 03 15 00, Concrete Accessories, prior to filling with repair material.

3.06 REPAIR OF LINED HOLES

A. This Article applies to openings with embedded material over all or a portion of inside surface of hole. Where indicated on the Drawings, remove embedded materials and repair the hole in accordance with Article 3.05 of this Section, as modified in this Article 3.06.

B. Where embedded material is allowed to remain, remove embedded material to at least two inches into the hole, as measured from the plane surface of concrete wall or slab, as applicable. Embedded material left in place shall be roughened or abraded for proper bonding to repair material. Completely remove substances that interfere with proper bonding.

C. Completely remove embedded items not securely and permanently anchored into concrete.

D. Completely remove embedded items larger than 12 inches in their smallest dimension. In lieu of removing the embedded item, where reinforcing is required as shown or indicated in the Contract Documents, weld reinforcing to embedded item to remain, provided embedded item to remain is composed of metal to which reinforcing steel can be welded.

3.07 REPAIR OF DETERIORATED CONCRETE

A. This Article pertains to deteriorated concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, or damage due to chemical attack. Use repair mortar, as specified in this Article, for repairing deteriorated concrete. Where repaired surface will be subsequently covered with plastic liner material, coordinate finishing with requirements for installing plastic liner material.

B. Surface Preparation: In addition to requirements of Article 3.02 of this Section, perform the following surface preparation:

1. Remove loose, broken, softened, and acid-contaminated concrete by abrasive blasting and chipping to sound, uncontaminated concrete.

2. Upon completion of removal of deteriorated concrete, notify ENGINEER in writing. Allow two weeks for ENGINEER to evaluate the surface, perform testing for acid contamination if required, determine if additional concrete shall be removed, and to develop special repair details (if any) required. Should ENGINEER determine that additional concrete be removed to reach sound, uncontaminated concrete, allow another two-week period for further evaluation and testing following the additional removal.

3. Surface preparation shall conform to recommendations of repair mortar manufacturer.

4. Repair and rehabilitate isolated areas of exposed reinforcing bars in accordance with Article 3.04 of this Section. If extensive areas of reinforcing steel are uncovered after removal of deteriorated concrete, ENGINEER will determine the repair methods required.

C. Repair Mortar Placing:

1. Conform to manufacturer's recommended procedures for mixing and placing repair mortar.

2. After initial mixing of repair mortar, addition of water is not allowed.

3. Minimum Thickness:

a. Install repair mortar to not less than minimum thickness recommended by manufacturer, and not less than 1/2-inch.

b. Where removal of deteriorated concrete results in repair thickness of less than minimum required thickness to return to original concrete surface in isolated

areas totaling less than ten percent of total repair surface area, remove additional concrete to obtain at least the required minimum thickness.

c. Where surface area with repair thickness less than minimum required thickness exceeds ten percent of total repair area, notify ENGINEER.

d. Provide repair mortar so that minimum cover over existing reinforcing steel is two inches. Do not place repair mortar creating locally raised areas.

e. Where transitioning to or from wall surfaces not requiring repair, do not feather-out repair mortar at transition. Instead, form the transition by saw cutting a score line to not less than minimum required repair mortar depth and chip out concrete to the saw cut line. Do not cut or otherwise damage reinforcing steel.

4. Place repair mortar to an even, uniform plane to restore concrete member to its original surface. Out-of-plane tolerance shall be such that the gap between 12-inch long straight edge and repair mortar surface does not exceed 1/8-inch, and gap between a four-foot long straight edge and repair mortar surface shall not exceed 1/4-inch. Tolerances specified in this paragraph apply to straight edges placed in any orientation at any location.

D. Finishing:

1. Provide smooth, steel trowel finish to repair mortar.

2. When completed, there shall be no sharp edges. Provide exterior corners, such as at penetrations, one-inch radius. Interior corners shall be square, except corners to receive plastic lining which shall be made with two-inch fillet in repair mortar.

3.08 REPAIR OF EXPANSION JOINTS

A. Surface Preparation: Remove the following from surfaces to be repaired: laitance, foreign material, and unsound concrete. Remove by chipping, abrasive blasting, or hydro blasting. Additional surface preparation, if required, shall be as recommended by expansion joint repair system manufacturer.

B. Installation: Installation shall be as recommended by expansion joint repair system manufacturer.

3.09 REPAIR OF EXPOSED REINFORCING

A. Remove, by abrasive blasting or hydro blasting, all corrosion, foreign materials, and unsound concrete from area to be repaired.

B. Surface shall be visually dry before applying corrosion inhibitor. Liberally apply corrosion inhibitor to achieve coverage of 100 square feet per gallon in two or more coats, by allowing corrosion inhibitor to soak into substrate. Time between coats shall be the longer of: one hour, or as recommended by corrosion inhibitor manufacturer. Apply using rollers, brushes, or hand-pressure spray equipment.

C. After applying final coat of corrosion inhibitor, minimum cure time of 24 hours is required.

D. Provide high-pressure wash to surfaces to be repaired to remove filmy residue from corrosion inhibitor.

E. For mortar coating, conform to Paragraphs 3.07C, 3.07D, 3.07.E of this Section.

3.10 CRACK INJECTION

A. Examine areas under which injection Work will be installed and locate cracks that require injection. Identify and inject cracks greater than 0.010-inch wide in structures that retain or contain water, wastewater, or similar liquid.

B. Install injection material in accordance with crack injection manufacturer's requirements.

C. After injecting and curing, verify that injected material penetrated the crack adequately and that there is no visible leakage through the crack. After injecting, if crack continues to leak, re-inject crack at no additional cost to OWNER until structure is watertight.

D. If proper penetration of crack cannot be achieved, submit to ENGINEER a proposed alternate approach for modifying the specified injection procedure to properly seal the crack. In new concrete and in concrete cracked as a result of CONTRACTOR's operations, perform modifications to crack injection procedure and fully repair the crack without additional cost to OWNER or extension of the Contract Times.

3.11 SITE QUALITY CONTROL

A. OWNER will employ and pay for services of testing laboratory for Site quality control testing. ENGINEER will direct the number of tests and specimens required, including providing necessary materials for making and facility for storing test specimens. CONTRACTOR shall make standard compression test specimens as specified in this Section under the observation of ENGINEER. CONTRACTOR shall provide:

1. Necessary assistance required by ENGINEER.

2. All labor, material, and equipment required, including rods, molds, thermometer, curing in heated storage box, and all other incidentals required, subject to approval by ENGINEER.

3. All necessary storage, curing, and transportation required for testing.

4. CONTRACTOR will be charged for cost of additional testing and investigation, if any, for Work performed that is not in accordance with the Contract Documents or is otherwise defective.

B. Site Tests of Cement-based Grouts and Repair Mortar:

1. Obtain compression test specimens during construction from first placement of each type of mortar or grout, and at intervals thereafter as selected by ENGINEER, to verify

compliance with the Contract Documents. Specimens will be made by ENGINEER or ENGINEER's representative.

2. Compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed in accordance with ASTM C109. Set of three specimens will be made for each test. Tests will be made at seven days, 28 days, and additional time periods as deemed appropriate by ENGINEER.

3. Material, already placed, failing to conform to the Contract Documents, is defective.

C. Repair Concrete: Repair concrete shall be tested as required in Section 03 30 00, Cast-In-Place Concrete.

END OF SECTION

SECTION 03 11 00

CONCRETE FORMING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete forming. The Work also includes:

a. Designing forming systems in accordance with requirements of ACI 347 and the Contract Documents.

b. Providing forming to accommodate the Work under this and other Sections and building into forming items such as sleeves, anchorage devices, inserts, pipe embedments, reinforcing, and all other items to be embedded in concrete for which placement is not specifically provided under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before concrete forming Work.

2. Coordinate forming Specifications with requirements for finished surfaces specified in Section 03 30 00, Cast-In-Place Concrete.

C. Related Sections:

1. Section 03 15 00, Concrete Accessories.

2. Section 03 30 00, Cast-In-Place Concrete.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary.

2. ACI 301, Specifications for Structural Concrete.

3. ACI 347, Guide to Formwork for Concrete.

4. ASTM C805/C805M, Test Method for Rebound Number of Hardened Concrete.

5. ASTM C1074, Practice for Estimating Concrete Strength by the Maturity Method.

6. NIST PS 1, Structural Plywood.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Professional Engineer:

a. CONTRACTOR or formwork Supplier shall retain a registered professional engineer legally qualified to practice in same state as the Site. Professional engineer shall have at least five years experience designing formwork and falsework of the type required.

b. Responsibilities include:

1) Reviewing formwork and falsework performance and design criteria stated in the Contract Documents.

2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.

3) Preparing or supervising preparation of design calculations verifying compliance of formwork and falsework with requirements of the Contract Documents.

4) Signing and sealing all calculations.

5) Certifying that:

a) Design of formwork and falsework was performed in accordance with performance and design criteria stated in the Contract Documents, and

b) Design conforms to all Laws and Regulations, and to prevailing standards of practice.

B. Mock-Ups for Concrete Finishes: Provide forming for mock-ups as required for finish work shown and specified for the Work. Place embedded materials in mock-up. Construct forms using facing materials such as form liners, where required, to provide specified finishes and to the requirements specified in Section 03 30 00, Cast-In-Place Concrete. Obtain ENGINEER'S acceptance of each mock-up prior to starting forming for the Work. Do not remove mock-up(s) until directed by ENGINEER.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Samples:

a. Plywood form material used for smooth form finish, four inches square minimum.

B. Informational Submittals: Submit the following:

1. Shop Drawings: When requested by ENGINEER, submit Shop Drawings showing and indicating general construction of individual forms, including:

   a. Jointing.

   b. Special formed joints or reveals.

   c. Location, pattern, and details of form tie placement, removal, and repair procedures.

   d. Location and details for temporary openings.

   e. Other items that would visually affect the finished concrete.

2. Design of Temporary Measures: Design of formwork and falsework is CONTRACTOR's responsibility. Submit the following:

   a. Falsework layout drawings with the seal and signature of CONTRACTOR's or Supplier's professional engineer. Layout drawings shall show bracing details, waler arrangements, location of shores, joint forming details, and details at connections to previously placed concrete. ENGINEER's review will be for general conformance to the requirements of the Contract Documents and ACI 347, as indicated for delegated design in the General Conditions.

   b. Design calculations for formwork and falsework, when requested by ENGINEER.

   c. Certification letter from CONTRACTOR's or Supplier's professional engineer stating that in-place falsework was inspected and complies with the intent of the falsework design.

3. Product Data: Manufacturer's data for proprietary materials, including form coatings, manufactured form systems, ties and accessories.

4. Manufacturer's Instructions: Installation instructions for proprietary materials, including form coatings, manufactured form systems, ties and accessories.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage:

1. Upon delivery to the Site, place materials in area protected from weather.

2. Store materials in accordance with manufacturer's recommendations.

3. Store materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.

B. Handle materials in accordance with the manufacturers' recommendations. Do not damage materials during handling.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. Design Criteria:

1. Design, erect, support, brace and maintain forming in accordance with ACI 347 so that forming safely supports vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by forming system or in-place construction that has attained adequate strength for the purpose. Construct forming so that concrete members and structures are of correct size, shape, alignment, elevation, and position.

2. Design forms and falsework to include values of live load, dead load, weight of moving equipment operated on forming, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.

3. Provide shores and struts with positive means of adjustment capable of taking up forming settlement during concrete placing operations, using wedges or jacks, or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

4. Support form facing materials by structural members spaced sufficiently close to prevent beyond tolerance deflection, in accordance with ACI 117. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. For long-span members without intermediate supports, provide camber in forming as required for anticipated deflections resulting from weight and pressure of fresh concrete and construction loads.

5. Design and construct forming to be readily removable without impact, shock or damage to concrete surfaces and adjacent materials.

6. Provide forming sufficiently tight to prevent leakage of cement paste during concrete placing. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

2.02 FORM MATERIALS

A. Forms for Smooth Finish Concrete:

1. Unless otherwise shown or indicated in the Contract Documents, construct forming for smooth concrete surfaces with plywood, metal, metal-framed plywood-faced, or other panel type materials acceptable to ENGINEER, to provide continuous, straight, smooth as-cast surfaces with no wood grain or other surface texture imparted by forming. Provide in largest practical sizes to minimize number of joints and to

conform to joint system shown or specified in the Contract Documents. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

B. Forms for Standard Finish Concrete:

1. Form concrete surfaces designated to have standard formed finish with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least two edges and one side.

C. Forms for Architecturally Finished Concrete:

1. Form finish concrete surfaces with units of face design, size, arrangement, and configuration as shown or as required to comply with approved Project job mock-up. Provide solid backing and form supports to ensure stability of form liners.

2. Form Material: Overlaid plywood in accordance with NIST PS 1. Provide B-B high density overlaid concrete form, Class I.

3. Form Liners: Rigid PVC or fiberglass in pattern shown or indicated.

4. Form Reuse: To be determined by ENGINEER at time of installation.

5. Rustication Joints: Rigid PVC in profile shown or indicated.

6. Panel Joints: Conceal joints behind rustication joints, unless approved by ENGINEER in writing.

D. Cylindrical Columns and Supports:

1. Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant type adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.

   a. Provide manufacturer's seamless units to minimize spiral gaps or seams.

2. Fiberglass or steel forms may be used for cylindrical columns if accepted by ENGINEER in writing.

E. Form Ties:

1. Provide factory-fabricated metal form ties, designed to prevent form deflection, and to prevent spalling of concrete surfaces upon removal.

2. Unless otherwise shown or indicated in the Contract Documents, provide ties so that portion of tie remaining within concrete after removal of exterior parts of tie is at least 1.5 inches from the outer concrete surface. Unless otherwise shown or indicated in the Contract Documents, provide form ties that will leave a hole no larger than one-inch diameter in concrete surface.

3. Ties shall have waterstops on all exterior, below-grade walls, and walls subject to hydrostatic pressure.

4. Ties shall leave a uniform, circular hole when forms are removed.

5. Do not use removable ties unless accepted by ENGINEER. Removable ties are not allowed on exterior below-grade walls or walls subject to hydrostatic pressure. If removable ties are accepted, CONTRACTOR shall submit hole repair details for ENGINEER approval.

6. Wire ties are not allowed.

7. Do not use reinforcing bars shown by the Drawings as part of the form tie system unless approved by ENGINEER.

8. Provide stainless steel form ties for areas with architectural finish. When used, tiebreak back point shall be at least one inch from outer concrete surface.

F. Form Coatings:

1. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compounds. For concrete surfaces that will be in contact with potable water or water that will be treated to become potable, form coating shall be a mineral oil base coating.

EXECUTION

2.03 INSPECTION

A. Examine substrate and conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

2.04 FORM CONSTRUCTION

A. Construct forms in accordance with ACI 347; to the exact sizes, shapes, lines, and dimensions shown; as required to obtain accurate alignment, location, and grades; to tolerances specified; and to obtain level and plumb work in finish structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes. Finish shall be in accordance with approved mock-up or sample panel, when specified.

B. Allowable Tolerances:

1. Construct forming to provide completed concrete surfaces complying with tolerances specified in ACI 117, ACI 301, and ACI 347.

a. Architectural finish forming, and where shown or indicated on the Drawings, shall be Class A surface, 1/8-inch offset.

b. Other surfaces exposed to view shall be Class B surface, 1/4-inch offset.

c. Other surfaces shall be Class C surface, 1/2-inch offset.

2. Tolerances apply to form offsets and to irregularities within the formed surface when measured with a straightedge over a five-foot distance.

C. Install forming and accessories for facilities in accordance with manufacturer's instructions, Laws and Regulations, and the Contract Documents.

D. Fabricate forms for easy removal without damaging concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

E. Provide temporary openings where interior area of forming is inaccessible for cleanout, for inspection before concrete placement, and for placing concrete. Brace temporary closures and set tightly to forms to prevent loss of cement paste. Locate temporary openings on forms in locations as inconspicuous as possible, consistent with requirements of the Work. Form intersecting planes of openings to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.

F. Falsework:

1. Erect falsework and support, brace, and maintain falsework to safely support vertical, lateral, and asymmetrical loads applied until such loads can be supported by in-place concrete structures. Construct falsework so that adjustments can be made for take-up and settlement.

2. Provide wedges, jacks or camber strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce finished Work of required dimensions.

G. Forms for Smooth Finish Concrete:

1. Do not use metal cover plates for patching holes or defects in forms.

2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.

3. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material that will produce bow.

4. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.

5. Form molding shapes, recesses, rustication joints and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

H. Corner Treatment:

1. Form exposed corners of beams, walls, foundations, bases and columns to produce smooth, solid, unbroken lines, except as otherwise shown or indicated in the Contract Documents. Chamfer exposed corners.

2. Form chamfers with 3/4-inch by 3/4-inch strips, unless otherwise shown or indicated in the Contract Documents, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Use rigid PVC chamfers for architecturally formed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

3. Reentrant or internal and unexposed corners may be formed either square or chamfered.

I. Joints:

1. For joint treatment, comply with Section 03 15 00, Concrete Accessories. Locate joints as shown and specified.

J. Openings and Built-In Work:

1. Provide openings in concrete forming shown or required under other Sections or other contracts. Refer to Paragraph 1.01B of this Section for coordination requirements.

2. Accurately place and securely support items to be built into forms.

K. Sealing Forming:

1. Forming joints shall be tight-fitting or otherwise sealed to prevent loss of cement paste.

2. Provide forming resting against concrete surfaces with compressible gasket material between the concrete and edge of form, to fill irregularities and create tight seal.

L. Cleaning and Tightening:

1. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before concrete is placed. Retighten forms immediately after placing concrete, as required to eliminate cement paste leaks.

M. Tie Hole Repair:

1. Repair tie holes in accordance with Section 03 30 00, Cast-In-Place Concrete.

2.05 FORM COATINGS

A. Coat form contact surfaces with non-staining form-coating compound before installing reinforcing materials. Do not allow excess form coating material to accumulate in forms or come into contact with surfaces that will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.

B. Coat steel forms with non-staining, rust-preventative form oil, or otherwise protect against rusting. Do not use rust-stained steel forming.

C. For concrete surfaces that will be in contact with potable water or water that will be treated to become potable, form coating shall be mineral-oil base coating.

2.06 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into forming anchorage devices and other embedded items, shown, specified, or required under other Sections. Refer to Paragraph 1.01B of this Section for coordination requirements. Use necessary setting drawings, diagrams, instructions, and directions.

B. Edge Forms and Screeds Strips for Slabs:

1. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units to support screeds.

2.07 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Before placing concrete, check ties, tie cones, tie waterstops, embedded items, form coatings, forming stability, alignment, and tolerances. Make corrections and adjustments to ensure forming complies with intent of the forming design, proper stability of forming systems, and accurate size and location of concrete members.

2. During concrete placing, check forming and related supports to ensure that forms are not displaced and that completed Work will be within specified tolerances.

3. If forms are unsatisfactory in any way, either before or during concrete placing, stop or postpone placing of concrete until defects are corrected as required by CONTRACTOR's or Supplier's professional engineer and accepted by ENGINEER.

2.08 REMOVAL OF FORMS

A. Determination of time between placing concrete and removing forms is CONTRACTOR's responsibility. Requirements specified in this Section are minimum times and requirements intended to ensure that concrete will support its own weight, and do not consider additional effects of the construction. Additional effects of the construction shall be accounted for by CONTRACTOR when determining time for removing forming. Time for removing of forms is subject to ENGINEER's acceptance.

B. Comply with requirements of ACI 301 and ACI 347, except as indicated in the Contract Documents.

C. Removal of Forms for Walls, Columns, Sides of Beams and Girders, and Slab and Foundation Edges:

1. Comply with requirements of the table below:

Component	Average Daily Ambient Air Temperature (deg F)				Min. Concrete Compressive Strength for Form Removal
	Over 70 F	60 F to 70 F	50 F to 60 F	Below 50 F	
Walls	One day	Two days	Three days	See Para-graph 3.8.C.2 of this Section	750 psi
Columns	Two days	Three days	Four days		1000 psi
Side of beams and girders	One day	One day	Two days		500 psi
Slab and foundation edges	One day	One day	Two days		500 psi

2. When average daily ambient air temperature is below 50 degrees F, do not remove forms until concrete attains minimum compressive strength indicated in the table above for form removal, and comply with Paragraph 2.08.C.3.b of this Section.

3. Concrete Strength Requirements for Form Removal:

a. For other than beams and elevated slabs, do not remove forms until concrete attains minimum concrete compressive strength indicated in Table 03 10 00-A for form removal.

b. For beams and elevated slabs, do not remove supporting forms or shoring until concrete attains minimum of 90 percent of its specified compressive strength.

D. Alternative Criteria for Removing Forms for Walls, Columns, Sides of Beams and Girders, and Slab and Foundation Edges: CONTRACTOR has the option of submitting an alternative removal of forms table, together with supporting data, for ENGINEER's acceptance. Supporting data shall include representative field data for each different placement ambient temperature condition and minimum of three tests per temperature condition to ensure that accurate correlation between concrete strength and placement temperature is obtained.

E. Determination of In-place Concrete Strength:

1. Determine compressive strength of in-place concrete by compression test specimens cured at the Site under the same conditions of temperature and moisture as the concrete member under consideration.

2. Alternately, determine compressive strength of in-place concrete by maturity factor procedure in accordance with ASTM C1074 and approved by ENGINEER. Location of embedded thermistors or thermocouples shall be as approved by ENGINEER.

F. When high-early strength concrete is used, time for removing the forms will be developed at the Site from the age/strength relationships established for the materials and proportions used by tests in accordance with ACI 301.

G. Continue curing, including bottom surfaces of slabs and beams, after form removal in accordance with Section 03 30 00, Cast-In-Place Concrete.

2.09 PERMANENT SHORES

A. Provide permanent shores in accordance with ACI 347.

B. Reshores are not allowed.

2.10 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in the construction. Do not use split, frayed, delaminated, or otherwise damaged form facing material. Apply form coating compound material to concrete contact surfaces as specified for forming.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use “patched” forms for exposed concrete surfaces. Form surfaces are subject to ENGINEER’s approval.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 03 15 00

CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete accessories.

B. Related Sections:

1. Section 03 11 00, Concrete Forming.

2. Section 03 60 00, Grouting.

3. Section 07 92 00, Joint Sealants.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ACI 301, Standard Specifications for Structural Concrete.

2. ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

3. CRD-C572, U.S. Army Corps of Engineers Specifications for Polyvinyl- Chloride Waterstop.

1.03 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Layout of construction and expansion joint locations. Submit and obtain approval prior to submitting concrete reinforcement Shop Drawings.

b. For construction and expansion joints that require waterstops, submit layout of locations showing waterstop details. Indicate waterstop type, waterstop joint conditions, and details on how joint conditions will be handled.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions: Manufacturer's specifications and installation instructions for all materials required.

1.04 DELIVERY, STORAGE AND HANDLING

A. Transportation and Handling of Products:

1. Deliver materials to Site to ensure uninterrupted progress of the Work.

2. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:

1. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight. Comply with manufacturer's storage and protection requirements.

2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.01 WATERSTOPS

A. Polyvinyl Chloride (PVC):

1. Material Requirements:

a. Waterstops shall be extruded from elastomeric PVC compound containing plasticizers, resins, stabilizers, and other materials necessary to meet requirements of the Contract Documents and requirements of CRD-C572. Do not use reclaimed or scrap material.

b. Tensile strength of finished waterstop: 1,400 psi, minimum.

c. Ultimate elongation of finished waterstop: 280 percent, minimum.

d. Minimum thickness shall be 3/8-inch over entire width of waterstop.

e. Provide waterstops with minimum of seven ribs equally spaced at each end on each side. First rib shall be at the edge. Ribs shall be a minimum of 1/8-inch in height.

f. Provide waterstops with hog rings or factory-installed grommets anchored to exterior ribs to facilitate tying waterstop in position.

2. Split waterstops are not allowed.

3. Construction Joints: Waterstops shall be flatstrip ribbed type, six-inch minimum width, unless otherwise shown or indicated in the Contract Documents.

4. Expansion Joints: Waterstops shall be centerbulb ribbed type, nine-inch minimum width, unless otherwise shown or indicated in the Contract Documents. Centerbulb shall have minimum outside diameter of 7/8-inch.

5. Retrofit Applications: Waterstops shall be T-profile, centerbulb ribbed type with six-inch minimum projection into new concrete and anchored to the existing concrete via stainless steel anchor bolts and an epoxy bed.

6. Product and Manufacturer: Provide one of the following:

    a. W.R. Meadows, Inc.

    b. DCA Construction Products.

    c. Greenstreak Plastic Products Company.

    d. Paul Murphy Plastics Company.

    e. Vinylex Corporation.

    f. Or equal.

B. Hypalon:

1. Provide hypalon waterstops as shown or indicated in the Contract Documents, 40-mils thick.

2. Waterstop shall be an integral part of manufacturer's joint sealing system and shall be in accordance with manufacturer's published recommendations.

3. Product and Manufacturer: Provide one of the following:

    a. Sikadur Combiflex, as manufactured by Sika Corporation.

    b. Or equal.

C. Hydrophilic Waterstop Materials:

1. General Material Properties:

    a. Bentonite-free, and expandable by minimum of 80 percent of dry volume in presence of water to form watertight joint seal without damaging concrete in which material is cast. Provide only where shown or indicated in the Contract Documents.

    b. Material shall be composed of resins and polymers that absorb water and cause an increase in volume in completely reversible and repeatable process. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.

    c. Select materials that are recommended by manufacturer for type of liquid to be contained.

2. Hydrophilic Rubber Waterstop:

a. Minimum cross sectional dimensions shall be 3/16-inch by 3/4-inch.

b. Product and Manufacturer: Provide one of the following:

1) Duroseal Gasket, by BBZ USA, Inc.

2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.

3) Hydrotite, by Greenstreak Plastic Products Company.

4) Or equal.

3. Hydrophilic Sealant:

a. Hydrophilic sealant shall adhere firmly to concrete, metal, and PVC in dry or damp condition. When cured sealant shall be elastic indefinitely.

b. Product and Manufacturer: Provide one of the following:

1) Duroseal Paste, by BBZ USA, Inc.

2) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.

3) Hydrotite, by Greenstreak Plastic Products Company.

4) SikaSwell S, by Sika Corporation.

5) Or equal.

D. Injection Hose Waterstop System:

1. Injection Hose Waterstop:

a. Injection hose shall consist of PVC or neoprene central core of sufficient strength to resist weight of minimum of 25 vertical feet of fresh concrete placed upon it. Provide injection openings closely spaced in minimum of three locations equally spaced around perimeter of hose. Seal openings with strips of closed cell foam of consistency to act as one-way valves preventing entrance of cement paste while allowing free flow of injection material, pumped through hose, into the concrete joint surface.

b. Injection hose system shall be appropriate for injection of hydrophilic injection resin. Hose shall allow for vacuuming operations and repeated use. Construction of hose shall permit free discharge of specified injected grout into concrete without backwash, for entire length of hose.

c. Injection hose system shall be complete with hold-down clips, connection tubes, fittings, and injection connections designed to be mounted flush with concrete surface and sealed to allow future injections. All system components shall be provided by same manufacturer.

d. Product and Manufacturer: Provide one of the following:

1) Fuko Injection System, by BBZ USA, Inc.

2) SikaSwell Hose, by Sika Corporation.

3) Or equal.

2. Hydrophilic Injection Resin:

a. Hydrophilic injection resin shall be acrylate-ester based. Viscosity shall be less than 50 centipoises (cps). Resin shall be water soluble in its uncured state, solvent-free, and non-water reactive. In cured state, resin shall form solid, hydrophilic, flexible material resistant to permanent water pressure, and shall not attack bitumen, joint sealants, and concrete.

b. Product and Manufacturer: Provide one of the following:

1) Duroseal Inject 1K/2K, by BBZ USA, Inc.

2) Sika Injection 29, by Sika Corporation.

3) Or equal.

2.02 PREFORMED EXPANSION JOINT FILLER

A. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

2.03 CONCRETE CONSTRUCTION JOINT ROUGHENER

A. Provide water-soluble non-flammable, surface-retardant roughener.

B. Product and Manufacturer: Provide one of the following for the types of joints specified:

1. Rugasol-S, by Sika Corporation for horizontal joints only.

2. Concrete Surface Retarder-Formula S, by Euclid Chemical Company, for horizontal joints only.

3. Concrete Surface Retarder-Formula F, by Euclid Chemical Company, for vertical joints only.

4. TK-6100 Concrete Form Surface Retarder, by TK Products.

5. Or equal.

2.04 EPOXY BONDING AGENT

A. Provide a two-component epoxy-resin bonding agent.

B. Product and Manufacturer: Provide one of the following:

1. Sikadur 32 Hi-Mod LPL, by Sika Corporation.
2. Eucopoxy LPL, by the Euclid Chemical Company.
3. Resi-Bond J-58, by Dayton Superior.
4. Or equal.

2.05 EPOXY-CEMENT BONDING AGENT

A. Provide three component epoxy resin-cement blended formulated as bonding agent.

B. Product and Manufacturer: Provide one of the following:

1. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation.
2. Duralprep A.C., as manufactured by the Euclid Chemical Company.
3. Emaco P24, as manufactured by MBT/ChemRex.
4. Or equal.

2.06 JOINT SEALANT AND ACCESSORIES

A. For joint sealants and accessories used on isolation joints, control joints, and expansion joints, refer to Section 07 92 00, Joint Sealants.

2.07 CONCRETE BOND BREAKERS

A. Provide asphalt-saturated rag felt building paper, not less in weight than commercially known as 15 pound felt building paper, which weighs 15 pounds per 100 square feet.

B. Chemical Bond Breaker:

1. Provide medium solids resin solution chemical concrete bond breaker complying with ASTM C309, Type I, Class B.

PART 3 EXECUTION

3.01 INSPECTION

A. CONTRACTOR and installing Subcontractor, if any, shall examine substrate and conditions under which the Work is to be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 CONSTRUCTION JOINTS

A. Comply with requirements of ACI 301 and the Contract Documents.

B. Locate and install construction joints as shown or indicated on the Drawings. Where not shown or indicated, locate joints to not impair strength of the structure; position joints at points of minimum shear. Location of joints shall be approved by ENGINEER. In addition to joints shown or indicated on the Drawings, locate construction joints as follows:

1. In foundation mats, locate joints at spacing of approximately 40 feet. Joints shall be located within middle third of element span, unless otherwise shown or indicated on the Drawings. Element span shall be considered distance between piles or, as determined by ENGINEER, distance between bearing elements, such as columns, exterior walls and interior walls. Place concrete in strip pattern, unless otherwise shown or indicated on the Drawings.

2. In walls, locate joints at a maximum spacing of 40 feet. Locate joints away from wall intersections a minimum of one-quarter of the clear span distance between wall intersections measured horizontally.

3. In structural slabs and beams, joints shall be located within middle third of element span and shall be located in compliance with ACI 301, unless otherwise shown or indicated on the Drawings.

4. In slabs on grade, locate joints at spacing of approximately 40 feet. Place concrete in strip pattern, unless otherwise shown or indicated on the Drawings.

C. Horizontal Joints:

1. Roughen concrete at interface of construction joints by abrasive blasting, hydroblasting, or using surface retardants and water jets to expose aggregate and remove accumulated concrete on projecting rebar immediately subsequent to form stripping, unless otherwise approved by ENGINEER. Immediately before placing fresh concrete, thoroughly clean existing contact surface using stiff brush or other tools and stream of pressurized water. Surface shall be clean and wet, and free from pools of water at time of placing fresh concrete.

2. Remove laitance, waste mortar, and other substances that may prevent complete adhesion. Where joint roughening was performed more than seven days prior to concrete placing or where dirt or other bond reducing contaminants are on surface, perform additional light abrasive blasting or hydroblasting to remove laitance and all bond-reducing materials just prior to concrete placement.

D. Vertical Joints:

1. Apply roughener to the form in thin, even film by brush, spray, or roller in accordance with manufacturer's instructions. After roughener is dry, concrete may be placed.

2. When concrete has been placed, remove joint surface forms as early as necessary to allow for removal of surface retarded concrete. Forms covering member surfaces shall remain in place as required under Section 03 11 00, Concrete Forming. Wash loosened material off with high-pressure water spray to obtain roughened surface subject to approval by ENGINEER. Alternately, surface shall be roughened by

abrasive blasting or hydroblasting to expose aggregate. Outer one-inch of each side of joint face shall be masked and protected from blasting to avoid damaging member surface.

3.03 EXPANSION JOINTS

A. Comply with requirements of ACI 301 and this Section.

B. Locate and install expansion joints as shown and indicated in the Contract Documents. Install joint filler in accordance with manufacturer's instructions. Install sealants as specified in this Section.

3.04 CONTROL JOINTS

A. Provide control joints in non-water bearing slabs on grade as shown or indicated on the Drawings. Where control joints are not shown or indicated on the Drawings, space control joints at 24 to 36 times thickness of slab in both directions. Locate control joints only at places approved by ENGINEER.

B. A groove, with depth of at least 25 percent of the member thickness, shall be tooled, formed, or saw-cut in concrete. Groove shall be filled with joint sealant material in accordance with Section 07 92 00, Joint Sealants.

C. Where control joint is formed by sawcutting, make sawcut in presence of ENGINEER immediately after concrete has set sufficiently to support the saw and be cut without damage to concrete. Keep concrete continually moist during cutting. Joints shall be approximately 1/8-inch wide.

D. Control joints may be formed with tool or by inserting joint forming strip. After concrete has achieved design strength, remove upper portion of joint forming strip and fill void with sealant.

3.05 ISOLATION JOINTS

A. Provide isolation joint where sidewalk or other slab on grade abuts a concrete structure and slab on grade is not shown doweled into that structure. Form isolation joint by 1/2-inch joint filler with upper 1/2-inch of joint filled with sealant.

3.06 WATERSTOPS

A. General:

1. Comply with ACI 301 and this Section. Make joints in accordance with manufacturer's instructions.

2. Provide PVC waterstops, except where otherwise shown or indicated on the Drawings.

3. Provide waterstops in all joints where concrete construction is below grade or intended to retain liquid. Install waterstop to the higher of: at least 12 inches above grade, or 12 inches above overflow liquid level in tanks.

4. Waterstops shall be fully continuous for extent of joint and with waterstops in intersecting joints. Maintain waterstop continuity at transitions between waterstops in joints at different levels and orientations.

5. In vertical joints in walls that are free at the top, waterstops shall extend no closer than six inches from top of wall.

6. In placing concrete around horizontal waterstops, with waterstop flat face in horizontal plane, work the concrete under waterstops by hand to avoid forming air and rock pockets.

B. Polyvinyl Chloride Waterstop:

1. Waterstops shall be positively held from displacement during concrete placing. Tie waterstops to reinforcement or other rigid supports at maximum spacing of 18 inches so that waterstop is securely and rigidly supported in proper position during concrete placing. Continuously inspect waterstops during concrete placing to ensure proper positioning.

2. Perform splicing in waterstops by heat sealing adjacent waterstop sections in accordance with manufacturer's printed recommendations. The following is required:

   a. Material shall not be damaged by heat sealing.

   b. Splices shall have tensile strength of not less than 60 percent of unspliced material's tensile strength.

   c. Maintain the continuity of waterstop ribs and of its tubular center axis.

3. Only butt-type joints of ends of two identical waterstop sections shall be made while material is in forms.

4. Prefabricated PVC Waterstop Joint:

   a. Joints with waterstops involving more than two ends to be jointed together, and joints that involve an angle cut, alignment change, or joining of two dissimilar waterstop sections, shall be prefabricated by CONTRACTOR or manufacturer prior to placing in the forms.

   b. Prefabricated joints shall have minimum of 2.0 feet of waterstop material beyond joint in each direction.

   c. Install prefabricated joint assembly in the forms and butt-weld each two-foot end to a straight-run portion of waterstop in place in the forms.

5. Where centerbulb waterstop intersects and is jointed with non-centerbulb waterstop, seal end of centerbulb using additional PVC material as required.

6. Symmetrical halves of waterstops shall be equally divided between concrete placements at joints and centered within joint width, unless shown or indicated otherwise in the Contract Documents. Place centerbulb waterstops in expansion joints so that centerbulb is centered on joint filler material.

7. When waterstop is installed in the forms or embedded in first concrete placement and waterstop remains exposed to atmosphere for more than four days, implement suitable precautions to shade and protect exposed waterstop from direct rays of sun during entire exposure, until exposed portion of waterstop is embedded in concrete.

8. Protect waterstop placed in joints intended for future concrete placement from direct rays of the sun by temporary means until permanent cover is installed, so that waterstop is not exposed to direct rays of the sun for more than four days total.

C. Hypalon Waterstop:

1. Provide hypalon waterstop where shown or indicated on the Drawings.

2. Install in accordance with manufacturer's recommendations.

D. Hydrophilic Rubber Waterstop and Sealant:

1. Where a hydrophilic rubber waterstop or sealant is required in accordance with the Contract Documents, or where approved by ENGINEER, install waterstop or sealant in accordance with manufacturer's instructions and recommendations; except, as modified in the Contract Documents.

2. When requested by ENGINEER, provide manufacturer's technical assistance at the Site.

3. Locate waterstop or sealant as near as possible to center of joint. Waterstop or sealant shall be continuous around entire joint. Minimum distance from edge of waterstop to face of the member shall be three inches.

4. Where hydrophilic rubber waterstop is used in combination with PVC waterstop, hydrophilic rubber waterstop shall overlap PVC waterstop for minimum of six inches. Fill contact surface between hydrophilic rubber waterstop and PVC waterstop with hydrophilic sealant.

5. Where wet curing methods are used, apply hydrophilic rubber waterstop and sealant after curing water is removed and just prior to closing up of the forms for concrete placement. Protect hydrophilic rubber waterstop and sealant from direct rays of sun and from becoming wet prior to concrete placement. If material becomes wet and expands, allow material to dry until material has returned to original cross sectional dimensions before placing concrete.

6. Install hydrophilic rubber waterstop in bed of hydrophilic sealant, before skinning and curing begins, so that irregularities in concrete surface are completely filled and waterstop is bonded to sealant. After sealant has cured, install concrete nails, with washers of a diameter equal to waterstop width, to secure waterstop to concrete at maximum spacing of 1.5 feet.

7. Prior to installing hydrophilic sealant, wire brush or sandblast the concrete surface to remove laitance and other materials that may interfere with bonding. Metal and PVC surfaces to receive sealant shall be cleaned of paint and any material that may interfere with bond. When sealant alone is shown or indicated in the Contract Documents, place sealant placed in built-up bead which has a triangular cross section with each side of triangle at least 3/4-inch long, unless otherwise indicated in the Contract Documents. Do not place concrete until sealant has cured as recommended by sealant manufacturer.

E. Injection Hose Waterstop:

1. Provide injection hose waterstop where shown or indicated on the Drawings.

2. Install injection hose in maximum lengths recommended by manufacturer, but not greater than 40 feet.

3. Clean concrete surface of all debris prior to installing injection hose. Install injection hose on two-inch wide strip of unroughened concrete at center of member width in direct contact with concrete. Clamp hose into position with anchor clips set into concrete spaced no more than 10 inches on centers.

4. Where injection hose is used in combination with PVC waterstop, hose shall overlap PVC waterstop for minimum of six inches and shall be less than two inches away from PVC waterstop.

5. Provide each end of injection hose with solid injector hoses mounted to formwork using a fitting. Provide fitting with cover that seals hose from cement paste and serves as a removable and reinstallable cover for future reinjections. Mount fittings on dry side of member, unless shown otherwise on the Drawings.

6. Hose system shall not be injected until authorization is given by ENGINEER. When authorized, hose system shall be injected with hydrophilic resin in conformance with manufacturer's recommendations. Injection shall be by an applicator authorized by injection system manufacturer.

7. Injection system Supplier shall provide necessary supervision to satisfy ENGINEER that application conforms strictly to manufacturer's recommendations.

8. Prior to resin injection, flush hose system with water. At end of injection operation, clean the hose system in accordance with manufacturer's recommendations to facilitate future injections. Plug and cover injection and vent ends of system, leaving system ready for future reinjections.

3.07 BONDING AGENT

A. Use epoxy bonding agent for bonding of fresh concrete to concrete that has been in place for at least 60 days, and for bonding to existing concrete.

B. Use epoxy-cement bonding agent for the following:

1. Bonding toppings and concrete fill to concrete that has been in place for at least 60 days, and for bonding to existing concrete.

2. For locations where bonding agent is required and concrete cannot be placed within open time period of epoxy bonding agent.

3. Bonding of horizontal construction joints where joints are required in accordance with the Drawings or approved by ENGINEER for foundation mats that are five feet thick or greater.

C. Use cement-water slurry as bonding agent for toppings and concrete fill to new concrete. Cement water slurry shall be worked into surface with stiff bristle broom and place the concrete before cement-water slurry dries.

D. Handle and store bonding agent in accordance with manufacturer's printed instructions and safety precautions.

E. Mix bonding agent in accordance with manufacturer's instructions.

F. Before placing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with bonding agent not less than 1/16-inch thick. Place fresh concrete while bonding agent is still tacky (within its open time), without removing in-place bonding agent coat, and as directed by manufacturer.

3.08 BEARING PAD INSTALLATION

A. Neoprene Bearing Pad: Install with water insensitive adhesive in accordance with manufacturer's instructions.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete reinforcing.

2. Extent of concrete reinforcing is shown and indicated in the Contract Documents.

3. Work includes fabrication and placement of reinforcing including bars, ties, and supports, and welded wire fabric for concrete, encasements, and fireproofing.

B. Related Sections:

1. Section 03 15 00, Concrete Accessories.

2. Section 04 05 05, Unit Masonry Construction.

3. Section 05 05 33, Anchor Systems.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ACI 315, Details and Detailing of Concrete Reinforcement.

2. ACI 318, Building Code Requirements for Structural Concrete.

3. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.

4. ANSI/AWS D1.4, Structural Welding Code - Reinforcing Steel.

5. ASTM A82, Specification for Steel Wire, Plain, for Concrete Reinforcement.

6. ASTM A185, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

7. ASTM A615, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

8. ASTM A706, Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

9. ASTM A767, Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

10. ASTM A775, Specification for Epoxy-Coated Steel Reinforcing Bars.

11. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

12. Concrete Reinforcing Steel Institute (CRSI), CRSI 1MSP, Manual of Standard Practice.

13. ICC Evaluation Service (ES) AC 308, Acceptance Criteria for Post-Installed Anchors in Concrete Elements.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall meet requirements of ASTM E329 and shall have experience in the testing welded splices of reinforcing steel and tension testing of reinforcing bars set in adhesive in hardened concrete.

2. Installer of Adhesive Dowels: Shall be experienced and certified by manufacturer of adhesive as possessing necessary training for installing manufacturer's products. Distributors or manufacturer's representatives shall not provide product training unless qualified as certified trainers by anchor manufacturer.

B. Certifications:

1. Weld Procedures: For types of splices and grades of reinforcing used in the Work, weld procedures for welded reinforcing steel splices shall be certified in accordance with ANSI/AWS D1.4.

2. Welders: For types of splices and grades of reinforcing used in the Work, welders shall be certified for welding reinforcing steel splices in accordance with ANSI/AWS D1.4.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI 315, Parts A and B.

b. For walls, show elevations at minimum scale of 1/4-inch to one foot.

1) Elevations shall show all openings and reference details that identify additional reinforcing required around each opening.

2) Elevations shall denote each wall intersection and reference a detail that identifies additional reinforcing required at wall intersection. As an alternate to providing separate details for each wall intersection, provide

overall plan detailing only the additional wall intersection reinforcing for each wall intersection.

c. For slabs and mats, show top and bottom reinforcing on separate plan views.

1) Plans shall show all openings and shall reference details that identify additional reinforcing around each opening.

d. Show bar schedules, stirrup spacing, diagrams of bent bars, location of bar splices, length of lap splices, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing unless otherwise noted.

e. Provide plans and elevations detailing location, spacing, and lengths of masonry wall dowels, where masonry is required. Coordinate location of dowels with masonry openings and with standard modular spacing. Submit masonry wall dowels with reinforcing submittal for element into which masonry dowel will be embedded. Coordinate with Section 04 05 05, Unit Masonry Construction.

f. Splices shall be kept to a minimum. Avoid, when possible, splices in regions of maximum tensile stresses.

g. Drawings detailing location of all construction and expansion joints, as required under Section 03 15 00, Concrete Accessories, shall be submitted and approved before Shop Drawings for reinforcing are submitted.

h. Drawings detailing location, spacing, edge distance, and embedment depth of adhesive dowels. Adhesive system shall be submitted and approved before Shop Drawings with adhesive dowels are submitted.

2. Product Data:

a. Manufacturer's product data for adhesive, if not submitted under other Sections.

b. Adhesive manufacturer's test data and ICC ES report to verify specified capacity of adhesive dowels.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Steel manufacturer's certificates of mill analysis, tensile, and bend tests for reinforcing steel.

b. Certification of welders and weld procedures for splices.

c. Adhesive manufacturer's certification verifying that installer is qualified and using proper installation procedures.

2. Manufacturer's Instructions:

a. Installation instructions for adhesive systems.

3. Special Procedure Submittals; Description of reinforcing weld locations and weld procedures.

1.05 DELIVERY, HANDLING, AND STORAGE

A. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.

B. Store concrete reinforcing products to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars: Shall be deformed in accordance with ASTM A615, and as follows:

1. Provide Grade 60 for all bars, unless indicated otherwise.

B. Mechanical Couplers: Reinforcement bars may be spliced with mechanical connection. Connection shall be full mechanical connection that shall develop in tension or compression, as required, at least 125 percent of specified yield strength (fy) of bar in accordance with ACI 318 and ACI 350. Where splices at the face of wall are shown or approved by ENGINEER, form saver-type mechanical couplers may be used. Form-saver couplers shall have integral plates designed to positively connect coupler to formwork.

C. Steel Wire: Shall be in accordance with ASTM A82.

D. Welded Smooth Wire Fabric: Shall be in accordance with ASTM A185.

1. Furnish in flat sheets, not rolls.

E. Column Spirals: Hot-rolled rods for spirals, conforming to ASTM A615.

F. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing in place.

1. Use wire bar type supports complying with CRSI 1 MSP recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.

2. For slabs on grade, use precast concrete blocks, four inches square in plan, with embedded tie wire as specified by CRSI 1 MSP. Precast concrete blocks shall have same or higher compressive strength as specified for concrete in which they are located.

3. For concrete surfaces where legs of supports are in contact with forms, provide supports complying with CRSI 1 MSP as follows:

    a. At formed surfaces in contact with soil, weather, or liquid, or located above liquid, supports shall be CRSI Class 1 for maximum protection. Plastic coating on legs shall extend at least 0.5-inch upward from form surface.

    b. At interior dry surfaces (not located above liquid), supports shall be either Class 1 or Class 2 for moderate protection.

    c. At formed surfaces with an architectural finish, use stainless steel protected legs (Type B).

4. Over waterproof membranes, use precast concrete chairs.

G. Adhesive Dowels:

1. Dowels:

    a. Dowel reinforcing bars shall be deformed in accordance with ASTM A615, Grade 60.

2. Adhesive:

    a. Requirements for adhesive are specified under requirements for concrete adhesive anchors in Section 05 05 33, Anchor Systems.

2.02 FABRICATION

A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI 1 MSP. In case of fabricating errors, do not re-bend or straighten reinforcing in manner that injures or weakens material.

B. Unacceptable Materials: Reinforcing with one or more of the following defects is not allowed:

1. Bar lengths, bends, and other dimensions exceeding specified fabrication tolerances.

2. Bends or kinks not shown on approved Shop Drawings.

3. Bars that do not meet or exceed their ASTM specification requirements when hand-wire-brushed, with respect to cross section, nominal weight, or average height of deformations.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine the substrate and conditions under which concrete reinforcing is to be placed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with applicable recommendations of Laws and Regulations, applicable standards, and CRSI 1 MSP for details and methods of reinforcing placement and supports.

B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

1. Place reinforcing to obtain minimum concrete coverages specified in ACI 318, AC I 350, and the Contract Documents. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.

2. Prior to placing concrete, using surveyor's level or string line, demonstrate to ENGINEER that specified cover of reinforcing has been attained.

3. Do not secure reinforcing steel to forms with wire, nails, or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.

D. Allowable Placing Tolerances: Comply with ACI 318, Chapter 7 - Details of Reinforcement, and ACI 350, Chapter 7 - Details of Reinforcement, except as specified in this Section:

1. Concrete surfaces in contact with liquid shall have minimum of two inches of concrete over reinforcing steel.

E. Provide sufficient number of supports of strength required to carry reinforcing. Do not place reinforcing bars more than two inches beyond last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

F. Lap Splices:

1. Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars as shown on the Drawings.

G. Install welded wire fabric in lengths as long as practical. Lap adjoining pieces at least one full mesh and lace splices with 16-gage wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

H. Mechanical Couplers:

1. Mechanical butt splices shall be in accordance with recommendations of mechanical splicing device manufacturer. Butt splices shall develop 125 percent of specified minimum yield tensile strength of spliced bars or of smaller bar in transition splices. Bars shall be flame-dried before butt splicing. Provide adequate jigs and clamps or other devices to support, align, and hold longitudinal centerline of bars being butt spliced in straight line.

I. Welded Splices:

1. When field welding of reinforcing is required on the Drawings or allowed by ENGINEER in writing, welding of reinforcing bars shall conform to ANSI/AWS D1.4. Preheating and rate of cooling requirements shall be based on bar steel chemistry and ANSI/AWS D1.4. Welded splices shall be sized and constructed to transfer minimum of 125 percent of specified minimum yield tensile strength of spliced bars or of smaller bar in transition splices. Unless otherwise allowed by Engineer in writing, welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.

2. Welding of wire to wire, and of wire or welded wire fabric to reinforcing bars or structural steels, shall conform to applicable provisions of ANSI/AWS D1.4 and ENGINEER's requirements for the particular application.

3. After completing welding on coated reinforcing bars, repair coating damage as specified in this Section. Welds and steel splice members, when used to splice bars, shall be coated with same material used for repair of coating damage.

J. Adhesive Dowels:

1. Comply with manufacturer's written installation instructions and requirements of this Section.

2. Drill holes to adhesive system manufacturer's recommended drill bit diameter and to specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances indicated in ANSI B212.15. Core-drilled holes shall not be permitted.

3. Before setting adhesive dowel, hole shall be made free of dust and debris by method recommended by adhesive system manufacturer. Brush the hole with adhesive system manufacturer-approved brush and blow hole clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.

4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.

5. Prior to injecting adhesive into the drilled hole, dispense to an appropriate location for waste an initial amount of adhesive from the mixing nozzle until adhesive is a uniform color, indicating that product is properly mixed.

6. Inject adhesive into hole through injection system-mixing nozzle and extension tubes (as required) placed to bottom of hole. Withdraw nozzle's discharge end as adhesive is placed while keeping nozzle immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placing.

7. Twist dowel during insertion into partially-filled hole to ensure full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.

8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining or adjacent Work that could impose or impart load on the dowels. Do not begin adjoining or adjacent Work until dowels are successfully tested or when approved by ENGINEER.

9. Limitations:

   a. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with requirements of adhesive systems manufacturer during installation and adhesive system curing.

   b. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by adhesive system manufacturer. Cost of corrective measures, including but not limited to redesign of dowels due to decreased capacities, shall be paid by CONTRACTOR.

3.03 FIELD QUALITY CONTROL

A. Site Inspections and Tests:

1. General:

   a. Do not place concrete until reinforcing is inspected, and permission for placing concrete is granted by ENGINEER. Concrete placed in violation of this provision will be rejected.

   b. Do not close up formwork for walls and other vertical members until reinforcing is inspected, and permission for placing concrete is granted by ENGINEER. Concrete placed in violation of this provision will be rejected.

   c. Correct defective Work by removing and replacing or correcting, as required by ENGINEER.

   d. CONTRACTOR shall pay cost of corrections and subsequent testing required to confirm integrity of post-installed anchors.

   e. Testing laboratory shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

2. Site Tests:

a. OWNER will employ testing laboratory to perform field quality testing of adhesive dowels at the Site.

1) Testing shall comply with ASTM E488.

2) Test at least ten percent of each type of adhesive dowel. If one or more dowels fail the test, CONTRACTOR shall pay cost to test all dowels of same diameter and type installed on the same day as the failed dowel.

3) Test dowels to 60 percent of specified yield strength. ENGINEER will direct which dowels are to be tested.

4) Apply test loads with hydraulic ram.

5) Displacement of dowels shall not exceed D/10, where D is nominal diameter of dowel.

3. Inspection of Welded Splices: OWNER will employ testing laboratory to perform field quality control testing of welded splices. All welded splices shall be visually inspected. Radiographically test minimum of five percent of butt splice welds. Repair defective welds so that welds are completely sound.

B. Manufacturer's Services:

1. Provide qualified adhesive manufacturer's representative at the Site during initial installation of adhesive dowel systems to train installing personnel in proper selection and installation procedures. Manufacturer's representative shall observe to verify that installer demonstrates proper installation procedures for adhesive dowels and adhesive material. Each installer shall be certified in writing by manufacturer as qualified to install adhesive anchors.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install cast-in-place concrete.

2. The Work includes providing concrete consisting of portland cement, fine and coarse aggregate, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured. The Work also includes:

a. Providing openings in concrete to accommodate the Work under this and other Sections, and building into the concrete all items such as sleeves, frames, anchorage devices, inserts, and all other items to be embedded in concrete Work.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:

1. Class “A” concrete shall be steel-reinforced and includes the following:

a. All concrete, unless otherwise shown or indicated.

2. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following, unless otherwise shown or indicated:

a. Concrete fill within structures.

b. Duct banks.

c. Unreinforced encasements.

d. Curbs and gutters.

e. Sidewalks.

f. Thrust blocks.

3. Class “D” concrete shall be unreinforced and used where required as concrete fill under foundations, filling abandoned piping, and where “lean concrete” or “mudmat” is shown or indicated in the Contract Documents.

D. Related Sections:

1. Section 03 15 00, Concrete Accessories.

2. Section 03 60 00, Grouting.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO M 182, Specification for Burlap Cloth Made From Jute or Kenaf and Cotton Materials.

2. AASHTO TP23, Test Method for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

3. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary.

4. ACI 214R, Evaluation of Strength Test Results of Concrete.

5. ACI 301, Specifications for Structural Concrete.

6. ACI 302.1R, Guide for Concrete Floor and Slab Construction.

7. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.

8. ACI 305R, Specification for Hot Weather Concreting.

9. ACI 306R, Cold Weather Concreting.

10. ACI 309R, Guide for Consolidation of Concrete.

11. ACI 318, Building Code Requirements for Structural Concrete and Commentary.

12. ACI 350/350R, Code Requirements for Environmental Engineering Concrete Structures and Commentary.

13. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.

14. ASTM C33, Specification for Concrete Aggregates.

15. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Con-crete Specimens.

16. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

17. ASTM C94/C94M, Specification for Ready-Mixed Concrete.

18. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).

19. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

20. ASTM C143/C143M, Test Method for Slump of Hydraulic- Cement Concrete.

21. ASTM C150, Specification for Portland Cement.

22. ASTM C157/C157M, Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.

23. ASTM C171, Specification for Sheet Materials for Curing Concrete.

24. ASTM C172, Practice for Sampling Freshly Mixed Concrete.

25. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

26. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.

27. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

28. ASTM C330, Specification for Lightweight Aggregates for Structural Concrete.

29. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.

30. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

31. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

32. ASTM C989, Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.

33. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.

34. ASTM C1077, Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

35. ASTM C1240, Specification for Silica Fume Used in Cementitious Mixtures.

36. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.

37. ASTM D3574, Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams.

38. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials

39. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

40. ASTM E1643, Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

41. ASTM E1745, Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

42. NSF/ANSI 61, Drinking Water System Components - Health Effects.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Concrete Testing Laboratory:

a. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes. Employ different laboratories for design of concrete mixes and field testing.

1) Testing agency shall be in accordance with ASTM E329 and ASTM C1077.

2) Testing laboratory shall have been inspected and passed within previous two years by Cement and Concrete Reference Laboratory (CCRL) of NIST for: testing concrete aggregates, and for preparing and testing concrete trial batches with or without admixtures. Testing laboratory shall provide documentation indicating how deficiencies, if any, in most recent CCRL inspection report were corrected.

3) Selection of testing laboratory is subject to OWNER's acceptance.

4) Submit written description of proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities, and equipment, and other information requested by ENGINEER.

2. Water Reducing Admixture Manufacturer:

a. Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. Submit copy of manufacturer's quality assurance handbook to document program existence.

b. Manufacturer shall maintain a concrete testing laboratory approved by CCRL at NIST.

c. Manufacturer shall be capable of providing services of qualified field service representatives at the Site.

B. Laboratory Trial Batch:

1. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.

2. For classes of concrete that require air-entrainment, test the trial batch at highest percentage of air allowed for that class of concrete.

3. Perform the following testing on each trial batch:

   a. Aggregate gradation for fine and coarse aggregates.

   b. Fly ash testing to verify meeting specified properties, unless fly ash Supplier submits certification by an independent testing laboratory.

   c. Slump.

   d. Air content.

   e. Compressive strength based on three cylinders each tested at seven days and at 28 days.

   f. Shrinkage test in accordance with this Section, for Class "A" concrete.

4. Submit for each trial batch the following information:

   a. Project identification name and number (if applicable).

   b. Date of test report.

   c. Complete identification of aggregate source of supply.

   d. Tests of aggregates for compliance with the Contract Documents.

   e. Scale weight of each aggregate.

   f. Absorbed water in each aggregate.

   g. Brand, type, and composition of cementitious materials.

   h. Brand, type, and amount of each admixture.

   i. Amounts of water used in trial mixes.

   j. Proportions of each material per cubic yard.

   k. Gross weight and yield per cubic yard of trial mixtures.

   l. Measured slump.

   m. Measured air content.

n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28 day test, and for each design mix.

o. Shrinkage test results where required and as specified in this Section. Report results and averages for original length and at zero, seven, 14, 21, and 28 days of drying.

C. Certification of Concrete Mix:

1. The requirement for trial batch will be waived upon compliance with requirements of this Paragraph. Verify compressive strength of each specified mix by data from series of at least 30 consecutive tests that have been made within previous 12 months. Test is the average strength of all specimens of the same age fabricated from sample taken from a single batch of concrete. Tests shall have been made on concrete with identical mix design to mix design proposed for the Work, including sources of aggregate and manufacturers of cementitious materials and admixtures. Tests shall average above specified strength with no individual test falling more than 500 psi below specified strength and no three consecutive tests averaging below specified strength. Standard deviation for series of tests shall not exceed 640 psi in accordance with ACI 214.

D. Shrinkage Test:

1. Perform drying shrinkage tests for trial batch as specified in this Section.

2. Drying shrinkage specimens shall be four-inch by four-inch by 11-inch prisms with effective gage length of ten inches; fabricated, cured, dried, and measured in accordance with ASTM C157 modified as follows: remove specimens from molds at an age of 23 hours, plus-or-minus one hour, after trial batching; shall be placed immediately in water at 70 degrees F plus-or-minus three degrees F for at least 30 minutes; and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F plus-or-minus three degrees F. Measurement to determine expansion expressed as percentage of original length shall be made at age of seven days. Length at age of seven days shall be base length for drying shrinkage calculations (zero days drying age). Immediately afterward store specimens in humidity-controlled room maintained at 73 degrees F plus-or-minus three degrees F, and 50 percent (plus-or-minus four percent) relative humidity for remainder of test. Obtain measurements to determine shrinkage expressed as percentage of base length and report measurements separately for seven, 14, 21, and 28 days of drying after seven days of moist curing.

3. Determine drying shrinkage deformation of each specimen as the difference between base length (at zero days drying age) and length after drying at each test age. Determine average drying shrinkage deformation of specimens to nearest 0.0001-inch at each test age. If drying shrinkage of a specimen departs from average of that test age by more than 0.0004-inch, results obtained from that specimen shall be disregarded. Report results of shrinkage test to nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from same concrete used for

preparing drying shrinkage specimens. Tests shall be considered part of normal compression tests for the Work. Allowable shrinkage limitations shall be as specified in PART 2 of this Section.

E. Component Supply and Compatibility:

1. Provide all admixture materials from a single manufacturer.

Sample Panels:

2. Provide Sample panels of wall finishes, each at least 12 inches by 12 inches by three inches thick. Revise Sample panels to produce acceptable finished concrete surfaces.

    a. Provide additional Sample panels as required if original results are unsatisfactory as determined by ENGINEER.

3. Continuity of color and texture for exposed concrete surfaces is important. Maintain such controls and procedures, in addition to those specified, as necessary to provide continuous match of concrete Work with approved Samples.

F. Concrete Coordination Conference:

1. Conduct concrete coordination conference to review detailed requirements of CONTRACTOR's proposed concrete design mixes, to discuss procedures for producing proper concrete construction, and to clarify roles of the parties involved. CONTRACTOR shall organize and schedule the conference, and prepare and distribute to all parties attending conference minutes of the conference.

2. Conduct concrete coordination conference no later than 14 days after the date the Contract Times commence running. Conference shall be held at mutually agreed upon date and time; conference shall be held at the Site unless otherwise mutually agreed upon. Notify all parties to attend concrete coordination conference not less than five days prior to scheduled date of conference.

3. All parties involved in the concrete Work shall attend concrete coordination conference including, but not limited to, the following:

    a. CONTRACTOR.

    b. Field testing services representative.

    c. Concrete Subcontractor (if any).

    d. Reinforcing steel Subcontractor (if any) and reinforcing steel Supplier and detailer.

    e. Concrete Supplier.

    f. Admixture manufacturer's representative.

    g. ENGINEER.

h. Resident Project Representative (if any).

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. List of concrete materials and proportions for the proposed concrete mix designs. Include data sheets, test results, certifications, and mill reports to qualify the materials proposed for use in the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.

b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.

c. Ready-mixed Concrete: Submit the following information.

1) Physical capacity of mixing plant.

2) Trucking facilities available.

3) Estimated average amount of the specified concrete that can be produced and delivered to the Site during a normal, eight-hour day, excluding output to other customers.

2. Product Data:

a. Manufacturers' specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.

3. Samples:

a. Submit Samples of materials as specified and as requested by ENGINEER. Include with each Sample names of product and Supplier, and description.

B. Informational Submittals: Submit the following:

1. Certifications:

a. Notarized certification of conformance to reference standards used in this Section, when required by ENGINEER.

2. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94 along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Transportation, Delivery, and Handling:

1. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.

2. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.

B. Storage:

1. For storage, provide bins or platforms with hard, clean surfaces.

PART 2 PRODUCTS

2.01 GENERAL

A. All cementitious materials, admixtures, and other industrial-produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

2.02 CEMENTITIOUS MATERIALS

A. Cement:

1. Portland cement shall be Type II(MH) ASTM C150. Type I or Type II may be used in lieu of Type II(MH) when approved by ENGINEER.

2. Portland cement shall be produced by one facility. Alternate cement sources may be used provided that mix design has been approved and acceptable trial batch verifying performance has been made.

3. Do not use cement that has deteriorated because of improper storage or handling.

B. Fly Ash Mineral Admixture:

1. Mineral admixtures, when used, shall conform to the requirements of ASTM C618 Class F, except as follows:

a. The loss on ignition shall be a maximum of four percent.

b. The maximum percent of sulfur trioxide (SO3) shall be 4.0.

2. Fly ash shall be considered to be a cementitious material.

3. Laboratory trial batches shall be tested to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.

C. For all classes of concrete, when Type II(MH) Cement is used, fly ash may be used within the following percentages by weight. When Type I Cement is used, in lieu of Type II(MH) Cement, fly ash shall be used such that total tricalcium aluminate content (C3A) of the resulting cementitious material is not greater than eight percent.

1. When fly ash is used, material shall have minimum of 20 percent and maximum of 25 percent of total weight of cementitious material.

2.03 AGGREGATES

A. General:

1. Aggregates shall conform to ASTM C33, Class Designation 4S, and as specified in this Section.

2. Do not use aggregates containing soluble salts or other substances, such as iron sulfides, pyrite, marcasite, ochre, or other materials, that can cause stains on exposed concrete surfaces.

B. Fine Aggregate:

1. Provide clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances.

2. Dune sand, bank run sand, and manufactured sand are unacceptable.

C. Coarse Aggregate:

1. Provide clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:

a. Crushed stone, processed from natural rock or stone.

b. Washed gravel, either natural or crushed. Slag, pit gravel, and bank run gravel are unacceptable.

2.04 WATER

A. Water used in producing and curing concrete shall be clean and free of injurious quantities of oils, acids, alkalis, organic materials, and other substances that may be deleterious to concrete and steel.

2.05 CONCRETE ADMIXTURES

A. Provide admixtures in accordance with product manufacturer's published instructions. Admixtures shall be compatible with each other. Admixtures shall not contain thiocyanates, shall not contain more than 0.05 percent chloride ion, and shall be non-toxic in the concrete mix after 30 days. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise approved by ENGINEER.

B. Air Entraining Admixtures: ASTM C260.

1. Air entraining admixture shall be vinsol resin or vinsol rosin-based.

C. Water-Reducing Admixture: ASTM C494, Type A.

1. Proportion Class "A" and Class "B" concrete with non-air entraining, normal setting, water-reducing, aqueous solution of modified organic polymer. Admixture shall not contain lignin, nitrates, or chlorides added during manufacturing.

D. High Range Water-Reducing Admixture (HRWR): ASTM C494, Type F/G.

1. Use high range water-reducing admixture in the concrete classifications so specified or indicated. Use of HRWR admixture is allowed at CONTRACTOR's option in all other classifications of concrete. When used, HRWR admixture shall be added to concrete in accordance with admixture manufacturer's published instructions. Specific admixture formulation shall be as recommended by admixture manufacturer for Project conditions.

E. Set Control Admixtures: In accordance with ASTM C494. Use the following as required:

1. Type B, Retarding.

2. Type C, Accelerating.

3. Type D, Water reducing and Retarding.

4. Type E, Water reducing and Accelerating.

5. Type F, Water-reducing, high range admixtures.

6. Type G, Water-reducing, high range, and retarding admixtures.

F. Calcium Chloride: Do not use calcium chloride.

G. Shrinkage Reducing Admixture:

1. Shrinkage reducing admixture may be used in mix design when necessary to conform to specified shrinkage limitations, provided that specified strength requirements are complied with and there is no reduction in sulfate resistance in the concrete and no increase in concrete permeability.

2.06 PROPORTIONING AND DESIGN OF MIXES

A. Prepare concrete design mixes in accordance with the table below:

Table 03 30 00-A - CONCRETE DESIGN MIX CRITERIA

Concrete Class	Coarse Aggregate[1] Size A	Coarse Aggregate[1] Size B	Minimum Cementitious (lbs/cu yd)	Max. W/CM[4]	Slump[2]	Air (%)	Min. Comp Strength[3] (psi)
Class "A"	No. 57	No. 8	564	0.42	4" max.	4.5 +/- 1.5	4,500
Class "B"	No. 57 or No. 67		517	0.50	4" max.	4.5 +/- 1.5	3,000

Class "D"	Any ASTM C33	⟵ No requirements ⟶	2,000

Notes Applicable to Table:

1. Coarse aggregate size numbers refer to ASTM C33. Where Size A and B are designated in Table 03 30 00-A, it is intended that the smaller Size B aggregate is to be added, replacing a portion of the coarse or fine aggregate, in the minimum amount necessary to make a workable and pumpable mix with sand content not exceeding 41 percent of total aggregate.
2. Slumps indicated are prior to addition of high range water reducer (super plasticizer).
3. Mix designs shall be made for all but Class "D", which does not require trial batch, so that the compressive strength achieved for laboratory trial batches will not be less than 125 percent of specified design strength.
4. Quantity of water to be used in the determination of water-cementitious materials (W/CM) ratio shall include free water on aggregates in excess of SSD and water portion of admixtures.

B. Adjustment to Concrete Mixes: Mix design adjustments may be requested by CONTRACTOR when characteristics of materials, Site conditions, weather, test results, or other circumstances warrant; at no additional cost to OWNER and as approved by ENGINEER. Before using adjusted concrete mixes, laboratory test data and strength results shall be submitted to and approved by ENGINEER.

C. Admixtures:

1. Use air-entraining admixture in concrete, unless otherwise shown or indicated. Add air-entraining admixture at admixture manufacturer's prescribed rate to produce concrete at point of placement having air content within prescribed limits.

2. Use water-reducing or high-range water-reducing admixtures in all Class "A" concrete.

3. Use amounts of admixtures recommended by admixture manufacturer for climatic conditions prevailing at the Site at time of placing. Adjust quantities and types of admixtures as required to maintain quality.

D. If adding water at the Site is desired, withhold water at the batch plant so that specified water-cement (or cementitious material) ratio is not exceeded. Addition of water shall be accordance with ASTM C94. After high-range water-reducing admixture is incorporated into the batch, addition of water is not allowed.

E. Slump Limits with High-Range Water Reducer:

1. Slump shall not exceed four inches prior to adding high-range water reducer and shall not exceed eight inches, measured at point of placement, after adding high-range water reducer.

F. Shrinkage Limitation:

1. Concrete shrinkage for specimens cast in laboratory from trial batch with total water of 30.2 gallons per cubic yard or less, as measured at 21-day drying age and at 28-day drying age shall not exceed 0.039 percent and 0.045 percent, respectively. For trial batch with total water of 32.7 gallons per cubic yard or greater respective limits shall not exceed 0.035 percent and 0.040 percent. Limits in between shall be linear interpolated. Use mix design for construction that complies with trial batch shrinkage requirements. Shrinkage limitations apply to Class "A" concrete.

2. Trial Batch Does Not Comply with Shrinkage Limitation:

    a. If trial batch results do not comply with shrinkage limitation specified in the Contract Documents, redesign the mix to reduce shrinkage.

    b. After mix has been repeatedly redesigned and ENGINEER is satisfied that all reasonable means to provide concrete mix that complies with shrinkage requirement have been exercised; and mix design still fails to comply with shrinkage limitation in the Contract Documents, ENGINEER reserves the right to accept the higher-shrinkage mix, provided that the quantity of shrinkage reinforcing in structures is increased.

    c. "Reasonable means" will be construed as reducing the total water content to a maximum of 27 gallons per cubic yard, having the large aggregate blended so that eight percent to 18 percent of combined aggregate is retained on each sieve, using an alternate aggregate source, and a combination of these means.

    d. Basis for shrinkage reinforcing increase will be proportional to amount that shrinkage value is over the specified shrinkage limitation and will be determined by ENGINEER. The cost of providing additional shrinkage reinforcement will be paid by the Owner.

2.07 BONDING AGENT

A. Provide epoxy and epoxy-cement bonding agents in accordance with Section 03 15 00, Concrete Accessories.

2.08 CONCRETE CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M 182, Class 3.

B. Curing Mats: Shall be heavy carpets or cotton mats, quilted at four inches on centers, and weighing minimum of 12 ounces per square yard when dry.

C. Moisture-Retaining Cover: Provide one of the following, complying with ASTM C171:

1. Waterproof paper.

2. Polyethylene film.

3. White burlap polyethylene sheet.

2.09 FINISHING AIDS

A. Evaporation Retardant:

1. Product and Manufacturer: Provide one of the following:

a. Confilm, by Master Builders.

b. Eucobar, by Euclid Chemical Company.

c. SikaFilm, by Sika Corporation.

d. Or equal.

2.10 CRACK INJECTION MATERIALS

A. Structural Crack Repair System:

1. Epoxy for Injection: Low-viscosity, high-modulus moisture insensitive type.

2. Products and Manufacturers: Provide one of the following:

a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, by Sika Corporation.

b. Eucopoxy Injection Resin, by Euclid Chemical Company.

c. Or equal.

3. Product shall be listed in NSF/ANSI 61.

B. Non-structural Crack Repair System:

1. Hydrophobic Polyurethane Chemical Grout:

a. Provide hydrophobic polyurethane that forms a flexible gasket.

b. Products and Manufacturers: Provide one of the following:

1) SikaFix HH LV, by Sika Chemical Company.

2) Or equal.

c. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.

d. Minimum elongation of 250 percent in accordance with ASTM D3574.

e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.

f. Product shall be listed in NSF/ANSI 61.

2. Hydrophilic Acrylate-Ester Resin:

a. Hydrophilic crack repair system shall be acrylate-ester resin that forms a flexible gasket and increase in volume a minimum of 50 percent when in contact with water.

b. Products and Manufacturers: Provide one of the following:

1) Duroseal Multigel 850, manufactured by BBZ USA, Inc.

2) Or equal.

c. Product shall be listed in NSF/ANSI 61.

2.11 CONCRETE REPAIR MATERIALS

A. Concrete repair mortar shall be pre-packaged, polymer-modified cementitious repair mortar with the following minimum properties:

1. Compressive Strength at One Day: 2,000 psi (ASTM C109).

2. Compressive Strength at 28 Days: 6,000 psi (ASTM C109).

3. Bond Strength at 28 Days: 1,800 psi (ASTM C882 modified).

4. Material shall be listed in NSF/ANSI 61.

B. Products and Manufacturers: Provide one of the following:

1. Five Star Structural Concrete, by Five Star Products, Inc. Use formulation recommended by manufacturer for the specific application conditions.

2. SikaTop 122 Plus, SikaTop 123 Plus, SikaTop 111 Plus, or Sikacem 133, by Sika Corporation. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.

3. Emaco S88-CA or S66-CR, by Master Builders Inc. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.

4. Verticoat, Verticoat Supreme, or Euco SR-VO, by Euclid Chemical Company. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.

5. Or equal.

C. Cement Mortar: Shall consist of mix of one part cement to 1.5 parts sand with sufficient water to form trowelable consistency. Minimum compressive strength at 28 days shall be 4,000 psi. Where required to match the color of adjacent concrete surfaces, blend white portland cement with standard portland cement so that, when dry, patching mortar matches the color of surrounding concrete.

2.12 CHEMICAL HARDENER

A. Provide clear chemical hardener of fluosilicate family.

B. Product and Manufacturer: Provide one of the following:

1. Lapidolith, by Sonneborn ChemRex Inc.

2. Hornolith, by A.C. Horn, Inc.

3. Or equal.

2.13 SHAKE-ON METALLIC HARDENER

A. Provide metallic hardener formulated, processed, and packaged under stringent quality control at metallic hardener manufacturer-owned and -controlled factory. Hardener shall be a mixture of specially-processed and -graded aggregate, selected portland cement, and plasticizing agents.

B. Product and Manufacturer: Provide one of the following:

1. Euco-Plate H.D., by Euclid Chemical Company.

2. Masterplate 200, by Master Builders, Inc.

3. Or equal.

2.14 VAPOR RETARDER

A. Vapor Retarder:

1. Vapor retarder membrane shall comply with the following.

a. Water Vapor Transmission Rate, ASTM E96: 0.04 perms or lower.

b. Water Vapor Retarder, ASTM E1745: Meets or exceeds Class C.

c. Thickness of Retarder (plastic), ACI 302 1R: Not less than 10 mils.

2. Products and Manufacturers: Provide one of the following:

a. Stego Wrap 10-mil Vapor Retarder, by Stego Industries LLC.

b. Griffolyn 10-mil, by Reef Industries.

c. Moistop Ultra, by Fortifiber Industries.

d. Or equal.

B. Accessories:

1. Provide accessories by same manufacturer as vapor retarder.

2. Seam Tape:

    a. Tape shall have water vapor transmission rate (ASTM E96) of 0.3 perms or lower.

    b. Products and Manufacturers: Provide one of the following:

        1) Stego Tape by Stego Industries LLC.

        2) Griffolyn Fab Tape by Reef Industries.

        3) Moistop Tape by Fortifiber Industries.

        4) Or equal.

3. Vapor Proofing Mastic:

    a. Mastic shall have a water vapor transmission rate ASTM E96, 0.3 perms or lower.

4. Pipe Boots:

    a. Construct pipe boots from vapor barrier material, pressure sensitive tape, mastic, or a combination thereof, in accordance with manufacturer's recommendations.

2.15 SOURCE QUALITY CONTROL

A. Concrete materials may require testing, as directed by ENGINEER, at any time during the Work if concrete quality is in question. Provide access to material stockpiles and facilities at all times. Tests shall be done at no expense to OWNER.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine the substrate and conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 CONCRETE MIXING

A. General:

1. Concrete may be produced at batch plants or by the ready-mixed process. Batch plants shall comply with recommendations of ACI 304R and have sufficient capacity to produce concrete of qualities required and in quantities required to comply with the accepted Progress Schedule. All plant facilities are subject to acceptance of ENGINEER.

2. Mixing:

a. Mix concrete with a rotating type batch machine, except where hand mixing of very small quantities is approved by ENGINEER.

b. Remove hardened accumulations of cement and concrete from drum and blades to ensure proper mixing action.

c. Replace mixer blades upon loss of ten percent of mixer blades' original height.

B. Site Mixing:

1. When Site mixing of concrete is approved by ENGINEER mix all materials for concrete in a drum-type batch mixer.

a. For mixers of one cubic yard or smaller capacity, continue mixing at least 1.5 minutes but not more than five minutes after all ingredients are in the mixer, before any part of batch is released.

b. For mixers of capacity larger than one cubic yard, increase minimum 1.5 minutes of mixing time by 15 seconds for each additional cubic yard or fraction thereof.

2. Do not exceed mixer manufacturer's published rating of the mixer, or mixer nameplate capacity, for total volume of materials used per batch.

3. Equip mixer with automatic controls for proportioning materials and proper, measured quantities.

4. Do not exceed 45 minutes total elapsed time between intermingling of damp aggregates and cement to discharge of completed mix.

C. Ready-Mix Concrete:

1. Comply with ASTM C94 and the Contract Documents.

a. Plant Equipment and Facilities: Conform to requirements of NRMCA certification.

b. Mix concrete in revolving-type truck mixers that are in good condition and produce thoroughly-mixed concrete conforming to the Contract Documents.

c. Do not exceed rated capacity of mixer.

d. Mix concrete for minimum of two minutes after arrival at the Site, or as recommended by mixer manufacturer.

e. Do not allow drum to mix while in transit.

f. Mix at proper speed until concrete is discharged from mixer.

g. Maintain adequate facilities at the Site for continuous delivery of concrete at required rates.

h. Provide access to mixing plant for ENGINEER upon request.

D. Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery to prevent delay of placing concrete after mixing, or holding dry-mixed materials too long in mixer before the adding water and admixtures.

3.03 TRANSPORTING CONCRETE

A. Transport and place concrete not more than 90 minutes after water has been added to the dry ingredients.

B. Avoid spilling and separation of concrete mixture during transportation.

C. Do not place concrete in which the ingredients have separated.

D. Do not retemper partially set concrete.

E. Use suitable equipment for transporting concrete from mixer to forms.

3.04 PREPARATION FOR CONCRETING

A. Submit to ENGINEER laboratory trial batch test results for proposed mixes at least 15 days prior to start of Work. Do not begin concrete production until associated laboratory trial batch test result submittal has been approved by ENGINEER.

B. Notify ENGINEER a minimum of 24 hours in advance of placing concrete to allow for inspection of form work, joints, waterstops, reinforcement, embedded items, and vapor retarders. The section to be placed shall be fully prepared for concrete placement at the time of notice. Confirm inspection status with ENGINEER a minimum of 4 hours prior to concrete placement. Do not begin placing concrete until Work is in conformance with the Contract Documents.

C. Subgrade surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

D. Reinforcing steel and embedded items shall be completely cleaned of mortar, loose rust, form release compounds, dirt, or any other substance which would interfere with proper bonding with concrete. Protective coatings on embedded aluminum items shall continuously cover the surface to be in contact with concrete. Any defects in the coating shall be repaired.

E. Do not place concrete until flow of water entering space to be filled with concrete has been properly stopped or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. Do not deposit concrete underwater, and do not allow water to rise on concrete surfaces until concrete has attained its initial set. Do not allow water to flow over concrete surface in manner and or velocity that will injure concrete surface finish. Provide temporary pumping or other dewatering operations for removing water as required.

F. Prepare joint surfaces in accordance with Section 03 15 00, Concrete Accessories.

G. Installation of Vapor Retarder:

1. Provide vapor retarder under slabs-on-grade and outside walls to receive resilient floor finishes, carpet, ceramic and slate tile, chemical resistant coatings, and where shown or indicated on the Drawings.

2. Install in accordance with manufacturer's instructions, ASTM E1643, and the following:

a. Unroll vapor retarder with longest dimension parallel with direction of the pour.

b. Lap vapor retarder over footings and seal to foundation walls.

c. Overlap vapor retarder joints by six inches and seal with vapor retarder manufacturer's tape.

d. Seal penetrations, including pipes, in accordance with vapor retarder manufacturer's instructions.

e. Penetration of vapor retarder is not allowed except for reinforcing steel and permanent utilities.

f. Repair damaged areas of vapor retarder by providing, for each damaged area, patch of vapor retarder material and overlapping damaged area with the patch by six inches on each side, and securely and continuously taping all four sides of patch to undamaged vapor retarder.

3.05 CONCRETE PLACEMENT

A. General:

1. Place concrete continuously, so that no concrete will be placed on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. If section cannot be placed continuously, provide construction joints in accordance with Section 03 15 00, Concrete Accessories.

2. Deposit concrete as nearly as practical in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to action that may cause segregation.

3. Screed concrete that is to receive other construction to proper level to avoid excessive skimming or grouting.

4. Do not use concrete that becomes non-plastic and unworkable, or does not conform to required quality limits, or that has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the Site and dispose of it in conformance with Laws and Regulations.

5. Do not place concrete until forms, bracing, reinforcing, and embedded items are each in final position and secure.

6. Do not place footings in freezing weather unless adequate precautions are taken against frost action.

7. Do not place footings, piers or pile caps on frozen soil.

8. Unless otherwise instructed, place concrete only when ENGINEER is present.

9. Allow minimum of three days between adjoining concrete placements.

B. Bonding for Next Concrete Pour:

1. Prepare for bonding of fresh concrete to concrete that has set but is not fully cured, as follows:

a. Thoroughly wet the surface, but allow no free-standing water.

b. For horizontal surfaces place a six-inch layer of Construction Joint Grout, as specified in Section 03 60 00, Grouting, over the hardened concrete surface.

c. Place fresh concrete before the grout has attained its initial set.

2. Accomplish bonding of fresh concrete to fully cured, hardened, existing concrete by using a bonding agent as specified in Section 03 15 00, Concrete Accessories.

C. Concrete Conveying:

1. Handle concrete from point of delivery at the Site, transfer to concrete conveying equipment, and transfer to locations of final deposit as rapidly as practical by methods that prevent segregation and loss of concrete mix materials.

2. Provide mechanical equipment for conveying concrete to ensure continuous flow of concrete at delivery end of conveyor. Provide runways for wheeled concrete conveying equipment from concrete delivery point to locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice, and other deleterious materials.

3. Do not use chutes for distributing concrete, unless accepted by ENGINEER.

4. Pumping concrete is allowed, however do not use aluminum pipe for conveying concrete.

D. Placing Concrete into Forms:

1. Deposit concrete in forms in horizontal layers not deeper than 18 inches each and in manner that avoids inclined construction joints. Where placement consists of several layers, place concrete at such rate that concrete being integrated with fresh concrete while still plastic.

2. Do not allow concrete to free-fall within the form from height exceeding four feet. Where high-range water reducer is used to extend slump to at least six inches, maximum allowable free-fall of concrete is six feet. Use “elephant trunks” to prevent free-fall and excessive splashing of concrete on forms and reinforcing. Discontinue free-falls in excess of four feet if there is evidence of segregation.

3. Remove temporary spreaders in forms when concrete placing has reached elevation of such spreaders.

4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidating concrete in accordance with applicable recommended practices in ACI 309. Vibration of forms and reinforcing is not allowed unless otherwise accepted by ENGINEER.

5. Where height of concrete placement in walls exceeds 14 feet, provide temporary windows in formwork to facilitate vibration. Properly close temporary windows when height of concrete approaches windows. Determine location, size, and spacing of temporary windows to suit equipment used.

6. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly-spaced locations not farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate the layer of concrete and at least six inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcing and other embedded items without causing segregation of concrete mix.

7. Do not place concrete in beam and slab forms until concrete previously placed in columns and walls is no longer plastic.

8. Prevent voids in the concrete. Force concrete under pipes, sleeves, openings, and inserts from one side until visible from the other side.

E. Placing Concrete Slabs:

1. Deposit and consolidate concrete slabs in continuous operation, within limits of construction joints, until placing of a slab panel or section is completed.

2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcing and other embedded items and into corners.

3. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified in this Article for formed concrete structures.

4. Bring slab surfaces to correct elevation and level. Smooth the surface, leaving surface free of humps or hollows. Do not sprinkle water on surface while concrete is plastic. Do not disturb slab surfaces prior to commencing concrete finishing.

5. Where slabs are placed in conditions of high temperature or wind that could lead to formation of plastic shrinkage cracks, provide evaporation retardant applied in accordance with retardant manufacturer's recommendations, when required by ENGINEER.

F. Quality of Concrete Work:

1. Concrete shall be solid, compact, and smooth, and free of laitance, cracks, and cold joints.

2. Concrete for liquid-retaining structures, and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

3. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces with cracks or voids, that are unduly rough, or are defective in any other way. Thin patches or plastering are unacceptable.

4. Leaks through concrete that exhibit flowing water, and cracks, holes, or other defective concrete in areas of potential leakage, shall be repaired and made watertight.

5. Repair, removal, and replacement of defective concrete as directed by ENGINEER shall be at no additional cost to OWNER.

G. Cold Weather Placing:

1. Protect concrete Work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures, in compliance with ACI 306 and the Contract Documents.

2. When air temperature has fallen to or may be expected to fall below 40 degrees F, provide adequate means to maintain temperature in area where concrete is being placed between 50 degrees F and 70 degrees F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain temporary heating and protection as necessary so that ambient temperature does not fall more than 30 degrees F in the 24 hours following the seven-day period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.

3. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing for concrete as required to obtain concrete mixture temperature not less than 55 degrees F and not more than 85 degrees F at point of placement.

4. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Before

placing concrete, verify that forms, reinforcing, and adjacent concrete surfaces are entirely free of frost, snow, and ice.

~~5.~~ Do not use salt or other materials containing antifreeze agents. Do not use chemical accelerators or set-control admixtures unless approved by ENGINEER and tested in mix design proposed for use.

H. Hot Weather Placing:

1. When hot weather conditions exist that would impair the quality and strength of concrete, place concrete in compliance with ACI 305 and the Contract Documents.

2. When ambient air temperature is at or above 90 degrees F and rising, cool ingredients before mixing concrete to maintain concrete temperature at time of placement below 80 degrees F. When ambient air temperature is at or above 90 degrees F and falling, cool the ingredients before mixing concrete to maintain concrete temperature at time of placement below 85 degrees F. In no case shall the concrete temperature at time of placement exceed 90 degrees F.

3. Mixing water may be chilled, or chopped ice may be used to control concrete temperature provided the water equivalent of ice is calculated in total amount of mixing water. If required, reduce the time from addition of mix water to placement, or use set-retarding admixture.

4. Cover reinforcing materials with water-soaked burlap if ambient air temperature becomes too hot, so that reinforcing material temperature does not exceed ambient air temperature immediately before embedment of reinforcing in concrete.

5. Wet forms thoroughly before placing concrete.

6. Do not place concrete at temperature that causes difficulty from loss of slump, flash set, or cold joints.

7. Do not use set-control admixtures unless approved by ENGINEER in mix design.

8. Obtain ENGINEER's approval of substitute methods and materials proposed for use.

I. Underwater Placing:

1. Concrete placement in water will be allowed if conditions render it impossible or inadvisable to dewater excavations or liquid-retaining structures before placing concrete, and only when allowed by ENGINEER in writing.

2. Revise and submit concrete mix design to suit underwater placement, and obtain ENGINEER’s approval before commencing underwater placement of concrete. Deposit concrete by tremie method or other suitable means in continuous placement to prevent forming layers or intrusion of water.

3.06 FINISHING OF FORMED SURFACES

A. Standard Form Finish:

1. Standard form finish shall be basically smooth and even, but is allowed to have texture imparted by the form material used. Repair defects in accordance with the Contract Documents.

2. Use standard form finish for the following:

a. Exterior vertical surfaces from foundation up to one foot below grade.

b. Vertical surfaces not exposed to view.

c. Other areas shown or indicated.

B. Smooth Form Finish:

1. Produce smooth form finish by selecting form materials that will impart smooth, hard, uniform texture. Arrange panels in orderly and symmetrical manner with minimum of seams. Repair and patch defective areas in accordance with the Contract Documents.

2. Use smooth form finish for the following:

a. Exterior surfaces exposed to view.

b. Surfaces to be covered with coating material. Coating material may be applied directly to concrete or may be a covering bonded to concrete such as waterproofing, dampproofing, painting, or other similar system.

c. Interior vertical surfaces of liquid-containers.

d. Interior and exterior exposed beams and undersides of slabs.

e. Surfaces to receive abrasive blasted finish.

f. Surfaces to receive smooth rubbed or grout cleaned finish.

g. Other areas shown or indicated.

C. Grout Cleaned Finish:

1. Provide grout cleaned finish to concrete surfaces that have received smooth form finish and where defects have been repaired, as follows:

a. Combine one part portland cement to 1.5 parts fine sand by volume, and mix with water to consistency of thick paint. Blend standard portland cement and white portland cement, in proportions determined by trial patches, so that final color of dry grout will closely match adjacent concrete surfaces.

b. Thoroughly wet concrete surface and apply grout uniformly by brushing or spraying immediately to wetted surfaces. Scrub surface with cork float or stone to coat surface and fill surface holes. Remove excess grout by scraping, followed by rubbing with clean burlap to remove visible grout film. Keep grout damp during setting period by using fog spray on surface for at least 36 hours after final rubbing. Complete each area the same day the area is started, with limits of each area being natural breaks in the finished surface.

2. Use grout cleaned finish for the following:

a. Interior exposed walls and other vertical surfaces.

b. Exterior exposed walls and other vertical surfaces down to one foot below grade.

c. Interior and exterior horizontal surfaces, except exterior exposed slabs and steps.

d. Interior exposed vertical surfaces of liquid-containing structures down to one foot below normal operating liquid level.

e. Other areas shown.

D. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown or indicated.

3.07 SLAB FINISHES

A. Float Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Check and level the surface plane to tolerance not exceeding 1/4-inch in ten feet when tested with a ten-foot straightedge placed on surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.

2. Use float finish for the following:

a. Interior exposed horizontal surfaces of liquid-containing structures, except those to receive grout topping.

b. Exterior below-grade horizontal surfaces.

c. Surfaces to receive additional finishes, except as shown or indicated.

B. Trowel Finish:

1. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.

2. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten foot straight edge. Grind smooth surface defects that would otherwise project through applied floor covering system.

3. Use trowel finish for the following:

   a. Interior exposed slabs, unless otherwise shown or indicated.

   b. Slabs that receive one of the following: resilient flooring, carpeting, or ceramic tile.

C. Non-Slip Broom Finish:

1. Immediately after float finishing, slightly roughen concrete surface by brooming in direction perpendicular to main traffic route. Use fine fiber-bristle broom, unless otherwise directed by ENGINEER. Coordinate required final finish with ENGINEER before applying finish.

2. Use non-slip broom finish for the following:

   a. Exterior exposed horizontal surfaces subject to lightweight foot traffic.

   b. Interior and exterior concrete steps and ramps.

D. Shake-On Metallic Finish:

1. For each slab shown or indicated to receive shake-on metallic finish, provide application of shake-on metallic hardener at rate of two pounds per square foot. First shake shall comprise two-thirds of specified quantity of hardener. Provide first application after initial floating operation, unless climatic conditions dictate earlier application. Shake-on metallic hardener shall be floated in the second application. Surface shall be floated again after second application to properly bond hardener to base concrete slab. Surface shall then be troweled at least twice to smooth, dense finish.

2. Furnish field service upon five days notice by the hardener manufacturer to assist CONTRACTOR in obtaining maximum benefits of product under prevailing conditions at the Site. Hardener manufacturer's representative shall attend concrete coordination conference required in Article 1.03 of this Section.

3. Use shake-on metallic hardener finish with Class "C" concrete for slabs shown or indicated on the Drawings as receiving this finish.

4. Protect slabs against oil and greases. Remove from slab surface dripping, flaking, or loose substances and other bonded foreign particles that might prevent adhesion of finish.

5. Patch and repair other floor imperfections in accordance with hardener manufacturer's recommendations.

E. Scratched Finish:

1. After providing float finish, roughen concrete surface with rake before concrete's final set. Amplitude of surface shall be minimum of 1/4-inch.

2. Provide scratched finish for the following:

a. Horizontal surfaces that will receive grout topping or concrete equipment pad.

b. Surfaces so indicated on the Drawings or elsewhere in the Contract Documents.

3.08 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying, excessive cold or hot temperatures, and maintain without drying at relatively constant temperature for period necessary for hydration of cement and proper hardening of concrete.

2. Start curing after placing and finishing concrete, as soon as free moisture has disappeared from concrete surface. Keep surface continuously moist during entire curing period. Cure for a minimum of 10 days and in accordance with ACI 301 procedures. For concrete sections over 30-inches thick, the curing period shall be for a minimum of 14 days. Avoid rapid drying at end of final curing period.

3. For curing, use water that is free of impurities that could etch or discolor exposed concrete surfaces.

4. Confine water for curing to area being cured.

B. Curing Methods: Curing methods are specified below. Curing methods to be used on each type of concrete surface are specified elsewhere in this Article.

1. Water Curing. Cure by one of the following methods:

a. Keep concrete surface continuously wet.

b. Ponding or immersion.

c. Continuous water-fog spray.

d. Covering concrete surface with curing mats, thoroughly saturating mats with water, and keeping mats continuously wet with sprinklers or porous hoses. Place curing mats to cover concrete surfaces and edges with four-inch horizontal

lap over adjacent mats; provide eight-inch lap over adjacent mats at vertical surfaces. If necessary, weigh down curing cover to maintain contact with concrete surface.

2. Form Curing. Cure by one of the following methods:

   a. Forms shall be maintained and loosened during curing period.

   b. Immediately after forms are loosened or removed, continue with the required curing method as applicable, for remainder of curing period.

   c. Where wood forms are kept in place, apply water to keep forms wet.

3. Moisture Retaining Cover Curing. Cure as follows:

   a. Cover concrete surfaces with the required moisture retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least three inches and sealed using waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover material and waterproof tape.

C. Formed Surfaces: Use the following curing methods:

1. Walls That Will Retain Liquid or That are Under Ground Surface:

   a. If forms are wood, form curing is allowed for entire curing period. If forms are steel, form curing is allowed for maximum of three days after which forms shall be removed so that concrete is free of the forms for remainder of the curing process.

   b. Immediately after the forms are loosened or removed, continue with water curing for remainder of curing period.

2. Formed Slab Underside and Beam Surfaces Where Will Retain Liquid:

   a. Form curing is allowed for the full curing period.

   b. Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.

3. Vertical Joint Surfaces and Surfaces to Receive Surface Treatment:

   a. Form curing is allowed for entire curing period.

   b. Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.

4. Cure other formed surfaces using an appropriate curing method specified in the Contract Documents.

D. Unformed Surfaces: Treat with one of the following curing methods:

1. Slabs and Mats That Will Retain Liquid or are Below Ground Surface:

    a. Water curing.

    b. Moisture-retaining cover curing when allowed by ENGINEER.

2. Construction Joint Surfaces and Slab and Mat Surfaces to Receive Surface Treatment.

    a. Water curing.

    b. Moisture-retaining cover curing.

3. Cure other formed surfaces using an appropriate curing method specified in the Contract Documents.

E. Temperature of Concrete During Curing:

1. When ambient temperature is 40 degrees F or less, continuously maintain concrete temperature between 50 degrees F and 70 degrees F throughout curing period. When necessary, before concrete placing provide for temporary heating, covering, insulation, or housing as required to continuously maintain specified temperatures and moisture conditions throughout concrete curing period. Provide cold weather protection in accordance with ACI 306.

2. When the ambient temperature is 80 degrees F and above, or during other climatic conditions that would cause too-rapid drying of concrete, before starting concrete placing, provide wind breaks and shading as required, and fog spraying, wet sprinkling, or moisture retaining coverings as required. Continuously protect concrete throughout concrete curing period. Provide hot weather protection in accordance with ACI 305, unless otherwise specified.

3. Maintain concrete temperature as uniformly as possible, and protect from rapid ambient temperature changes. Avoid concrete temperature changes that exceed five degrees F in one hour and 50 degrees F in 24-hour period.

F. Protection:

1. During curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and damage by rain and flowing water. Protect finished concrete surfaces from damage by subsequent construction operations.

3.09 CONCRETE INSTALLATION TOLERANCES

A. Installation Tolerances:

1. Concrete placement tolerances, unless otherwise specified in the Contract Documents, shall be in accordance with ACI 117.

2. Notify ENGINEER in writing when concrete placement does not conform with required tolerances, as soon as the condition is known to CONTRACTOR.

3. When concrete installation does not conform to required tolerances, do not repair or correct by grinding unless specified in the Contract Documents or approved by ENGINEER in writing.

4. Verification Measurements:

   a. If surfaces where tolerances are in question, obtain measurements to verify conformance with tolerances in manner acceptable to ENGINEER.

   b. If surfaces tolerances are in question, cost of obtaining measurements shall be at no additional cost to the OWNER.

   c. Before obtaining measurements, obtain ENGINEER's acceptance of method proposed for obtaining measurements.

   d. After obtaining measurements, submit measurements to ENGINEER.

5. Submit with verification measurements submittal proposed method to rectify out-of-tolerance concrete. Do not start repair Work without obtaining ENGINEER's approval.

3.10 FIELD QUALITY CONTROL

A. Field Testing Services:

1. OWNER will employ testing laboratory to perform field quality control testing for concrete. ENGINEER will direct the testing requirements.

2. Testing laboratory will make standard compression test cylinders and entrained air tests as specified in this Article, under observation of ENGINEER or Resident Project Representative.

3. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.

4. CONTRACTOR shall provide all curing and necessary cylinder storage as specified in Section 01 45 28, On-Site Facilities for Testing Laboratory.

B. Quality Control Testing During Construction:

1. Perform sampling and testing for field quality control during placement of concrete, as follows:

   a. Sampling Fresh Concrete: ASTM C172.

   b. Slump: ASTM C143; one test for each concrete load at point of discharge.

c. Concrete Temperature: ASTM C1064; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.

d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.

e. Unit Weight: ASTM C138; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.

f. Compression Test Specimens:

1) In accordance with ASTM C31; make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.

2) Cast, store, and cure specimens in accordance with ASTM C31.

3) Test and record the following when cylinders are cast: slump, concrete temperature, air content, and unit weight.

g. Compressive Strength Tests:

1) In accordance with ASTM C39; one specimen tested at seven days, and three specimens tested at 28 days.

2) Adjust mix design if test results are unsatisfactory and resubmit for approval.

3) Concrete that does not comply with strength requirements will be considered as defective Work.

h. Water/Cementitious Materials Ratio: Perform one test from each sample from which compression test specimens are taken, in accordance with AASHTO TP23.

i. Within 24 hours of completion of test, testing laboratory will submit certified copy of test results to CONTRACTOR and ENGINEER.

C. Evaluation of Field Quality Control Tests:

1. Do not use concrete delivered to final point of placement having slump, concrete temperature, total air content or unit weight outside specified values.

2. Water/Cementitious Materials Ratio:

a. When water content testing indicates water/cementitious materials ratio to exceed specified requirements by greater than 0.02, remaining batches required to complete concrete placement shall have water content decreased in the mix and water reducing admixture dosage increased as required to bring

subsequently-batched concrete within specified water/cementitious materials ratio.

b. Perform additional testing to verify compliance with specified water/cementitious materials ratio.

c. Do not resume concrete production for further concrete placement until CONTRACTOR has identified cause of excess water in the mix and revised batching procedures, or adjusted the mix design (and obtained ENGINEER's associated approval) to bring water/cementitious materials ratio into conformance with the Contract Documents.

3. Compressive Strength:

a. Compressive strength tests for laboratory-cured cylinders will be acceptable if the averages of all sets of three consecutive compressive strength tests results equal or exceed specified 28-day design compressive strength of the associated type or class of concrete, and no individual strength test falls below required compressive strength by more than 500 psi.

b. Questionable Field Conditions During Concrete Placement:

1) Where questionable field conditions exist during concrete placement or immediately thereafter, strength tests of specimens cured under field conditions will be required by ENGINEER to check adequacy of curing and protecting of concrete placed. Specimens shall be molded at the same time and from the same samples as laboratory-cured specimens.

2) Provide improved means and procedures for protecting concrete when 28-day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory cured cylinders.

3) When laboratory-cured cylinder strengths are appreciably higher than minimum required compressive strength, field-cured cylinder strengths need not exceed minimum required compressive strength by greater than 500 psi even though the 85 percent criterion may not be met.

4) If individual tests of laboratory-cured specimens produce strengths more than 500 psi below the required minimum compressive strength, or if tests of field-cured cylinders indicate deficiencies in protection and curing, provide additional measures to ensure that load-bearing capacity of the structure is not jeopardized or impaired. If likelihood of low-strength concrete is confirmed and evaluations indicate load-bearing capacity may have been reduced, perform tests of cores from the concrete in question at CONTRACTOR's expense.

c. If compressive strength tests fail to indicate compliance with minimum requirements of the Contract Documents, concrete represented by such tests will be considered defective.

D. Concrete Tolerance Verification Measurements: Refer to Article 3.09 of this Section.

E. Supplier's Services:

1. Water-Reducing Admixture Manufacturer: Furnish services of qualified concrete technician employed by admixture manufacturer to assist in proportioning concrete for optimum use of admixture. Concrete technician shall advise on proper addition of admixture to concrete and on adjustment of concrete mix proportions to meet changing conditions at the Site.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Temporary Openings:

1. Openings in concrete walls and slabs required for passage of Work are allowed only upon approval of ENGINEER.

2. Temporary openings made in concrete shall be provided with waterstop in below-ground or liquid-retaining members and structures. Reinforcement going through and around the opening shall be made continuous to provide continuity and shall be approved by the ENGINEER.

3. Temporary openings that remain in concrete structures shall be filled with the same class of concrete as the adjoining construction, after the Work causing need for temporary opening is complete, unless otherwise shown or directed by ENGINEER. Mix, place, and cure concrete as specified in this Section to blend with in-place construction. Provide miscellaneous concrete filling shown or required to complete the Work.

B. Bases or Pads for Piping, Panels, and Equipment:

1. Unless specifically shown or indicated otherwise, provide concrete bases or pads for equipment, floor-mounted panels, and floor-mounted supports for piping and similar construction. Provide all concrete pad and base Work not specifically included under other Sections.

2. Dimensions and Elevations:

a. Coordinate and construct bases and pads to dimensions shown or indicated, or as required to comply with equipment, panel, or piping manufacturer's requirements and elevations indicated on the Drawing.

b. Unless otherwise shown or indicated, place concrete bases for equipment up to one-inch below the equipment manufacturer's base or mounting plate.

c. Where specific dimensions or elevations are not shown or indicated, bases and pads shall be six inches thick and extend three inches outside dimensions of the equipment, panel, or supports.

3. Finish: Bases and pads outside of areas to receive non-shrink grout shall have smooth trowel finish, unless special finish such as terrazzo, ceramic tile, quarry tile, or heavy-duty concrete topping is required. In such cases, provide appropriate concrete finish. Surfaces of bases and pads to receive non-shrink grout shall have broom finish.

C. Curbs:

1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green followed by steel-troweling surfaces to hard, dense finish with corners, intersections, and terminations slightly rounded.

2. Exterior curbs shall have rubbed finish for vertical surfaces and broomed finish for top surfaces.

3.12 REPAIR OF CONCRETE PLACED UNDER THIS CONTRACT

A. Repair of Formed Surfaces:

1. Repair the following defects in all formed finishes:

a. Spalls, air bubbles, rock pockets, form depressions, and other defects that are more than 1/4-inch in depth.

b. Holes from tie rods and other form tie systems.

c. Fins, offsets, and other projections that extend more than 1/4-inch beyond designated concrete member surface.

d. Structural cracks, as defined by ENGINEER.

e. Non-structural cracks greater than 0.010-inch wide as defined by ENGINEER. In liquid-retaining structures, elevated slabs subject to the elements or washdowns, below-grade members, and cracks that evidence leakage. Where it is not possible to verify whether a crack is leaking, repair the crack.

2. Repair the following defects in smooth-finish surfaces, in addition to those listed above in this Section:

a. Spalls, air bubbles, rock pockets, form depressions, and other defects that extend to more than 1/2-inch in width in any direction, no matter how deep.

b. Spalls, air bubbles, rock pockets, form depressions, and other defects of any size that exceed three in number in a 12-inch by 12-inch area, or 12 in number in a three-foot by three-foot area.

c. Fins, offsets, and other projections shall be completely removed and smoothed.

d. Scratches and gouges in concrete surface.

e. Texture and color irregularities. In liquid-retaining surfaces, texture and color irregularities need not be repaired when greater than 12 inches below minimum

normal operating liquid surface elevation, except where such defects are indicative of reduced durability.

3. Where smooth rubbed or grout cleaned finish is specified, minor surface defects repairable by the finishing process need not be repaired prior to finish application, when approved by ENGINEER.

B. Method of Repair of Formed Surfaces:

1. Immediately after removing forms, repair and patch defective areas with cement mortar or concrete repair mortar as directed by ENGINEER. Make repairs made to liquid-retaining structures and below-grade surfaces with repair mortar only. Repair form tie holes in liquid-retaining or below-grade surfaces with non-shrink grout in accordance with Section 03 60 00, Grouting.

2. Honeycombs, Rock Pockets, and Holes Left by Tie Rods and Bolts:

a. Cut out honeycomb, rock pockets, voids, and holes left by tie rods and bolts, down to solid concrete but, in no case, to depth less than one-inch for cement mortar and 1/2-inch for repair mortar. Make edges of cuts perpendicular to concrete surface.

b. Before placing cement mortar, thoroughly clean and brush-coat area to be patched with specified bonding agent.

c. When using concrete repair mortar, use of bonding agent is optional; prepare the surface and place mortar in accordance with mortar manufacturer's recommendations.

d. Repairs at exposed-to-view surfaces shall match the color of surrounding concrete, except color matching is not required for interior surfaces of liquid-retaining surfaces up to one foot below typical minimum liquid level. Impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture, and color match before proceeding with patching.

e. Compact mortar in place and strike off slightly higher than the surrounding surface.

3. Structural Cracks: Pressure-grout structural cracks using injectable epoxy installed using pressurized system. Apply in accordance with epoxy manufacturer's directions and recommendations.

4. Non-structural Cracks: Shall be pressure-grouted using hydrophobic or hydrophilic resin. Install in accordance with resin manufacturer's directions and recommendations.

5. Determination of the crack type shall be made by the ENGINEER.

6. Holes Through Concrete:

a. Using plunger-type gun or other suitable device, fill holes extending through concrete from least-exposed face, using flush stop held at exposed face; completely fill the hole with specified repair material.

b. At below-grade and liquid-containing members, fill holes with concrete repair mortar and use color-matched cement mortar for outer two inches at exposed-to-view surfaces.

7. Where powerwashing or scrubbing is not adequate, abrasive blast exposed- to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to specified tolerances for each surface and finish. Correct low and high areas in accordance with this Section.

2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using template having the required slope. Correct high and low areas in accordance with this Section.

3. Repair finish of unformed surfaces containing defects that adversely affect concrete durability. Surface defects include crazing, cracks in excess of 0.01-inch wide, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

4. Repair structural cracks in all structures and non-structural cracks in liquid-retaining structures. In liquid-retaining structures, where dry face of concrete member can be observed, repair all cracks evidencing any rate of water flow through crack. Where dry face of member cannot be observed, repair all cracks.

D. Methods of Repair of Unformed Surfaces:

1. Correct high areas in unformed surfaces by grinding, after concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.

2. Correct low areas in unformed surfaces, during or immediately after completion of surface finishing, by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Where repairs are required and concrete has already set, sawcut around perimeter of area to be repaired to depth of 1/2-inch and remove concrete so that minimum thickness of repair is 1/2-inch. Apply specified concrete repair mortar in accordance with repair mortar manufacturer's directions and recommendations.

3. Repair defective areas, except random cracks and single holes not exceeding one-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Minimum thickness of repair shall be 1.5 inches.

Dampen concrete surfaces in contact with patching concrete and brush with specified bonding agent. Place patching concrete while bonding agent is tacky. Mix patching concrete of same materials and proportions to provide concrete of same classification as original, adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

4. Repair isolated, random, non-structural cracks (in members that are not below grade or liquid-retaining), and single holes not greater than one-inch diameter, by dry-pack method. Groove top of cracks, and cut out holes to sound concrete, and clean repair area of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before cement grout takes its initial set. Mix dry-pack, consisting of one part portland cement to 2.5 parts fine aggregate passing No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for at least 72 hours.

5. Structural cracks shall be pressure-grouted using injectable epoxy. Apply in accordance with epoxy manufacturer's directions and recommendations.

6. Non-structural cracks in below-grade and liquid-retaining structures shall be pressure-grouted using hydrophilic resin. Apply in accordance with resin manufacturer's directions and recommendations.

7. Determination of crack type will be by ENGINEER.

8. Ensure that surface is acceptable for flooring material to be installed in accordance with flooring manufacturer's recommendations.

E. Other Methods of Repair:

1. Repair methods not specified in this Section may be used when approved by ENGINEER.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install grout and perform grouting Work.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before grouting Work.

C. Related Sections:

1. Section 03 15 00, Concrete Accessories.

2. Section 03 30 00, Cast-In-Place Concrete.

D. Application and Grout Material:

1. The following is a listing of grouting applications and the corresponding type of grout material to be provided for the associated application. Unless shown or indicated otherwise in the Contract Documents, provide grout in accordance with the following:

Table 03 60 00-A - GROUT APPLICATIONS AND MATERIAL TYPES

Application	Required Grout Material Type
Beam and column (one- or two-story height) base plates and precast concrete bearing less than 16 inches in the least dimension	Class II Non-Shrink
Column base plates and precast concrete bearing (greater than two-story height or larger than 16 inches in the least dimension)	Class I Non-Shrink
Base plates for storage tanks and other non-motorized equipment, and motorized equipment or machinery less than 50 horsepower	Class I Non-Shrink (unless otherwise recommended by equipment manufacturer)
Motorized equipment or machinery equal to and greater than 50 horsepower, and motorized equipment or machinery equipment less than 50 horsepower subject to severe shock loads or high vibration	Class III Non-Shrink Epoxy (unless otherwise recommended by equipment manufacturer)

Filling blockout spaces for embedded items such as railing posts, guide frames for hydraulic gates, and similar applications	Class II Non-Shrink (Class I where placement time exceeds 15 minutes)
Grout fill or grout toppings less than four inches thick	Grout Fill
Grout fill greater than four inches thick	Class "B" Concrete in accordance with Section 03 30 00, Cast-In-Place Concrete
Grout for setting filter underdrain blocks, and for filling voids between filter underdrain blocks, and for filling voids between filter underdrain blocks and walls	Filter Underdrain Blocks Grout
Applications not listed above, where grout is indicated on the Drawings	Class I Non-Shrink, unless shown or indicated otherwise

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ACI 211.1, Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

2. ACI 301, Structural Concrete for Buildings.

3. ASTM C33/C33M, Specification for Concrete Aggregates.

4. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).

5. ASTM C230/C230M, Specification for Flow Table for Use in Tests of Hydraulic Cement.

6. ASTM C531, Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

7. ASTM C579, Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

8. ASTM C827, Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.

9. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

10. ASTM C939, Text Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).

11. ASTM C1107/C1107M, Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

12. ASTM C1181, Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

13. NSF/ANSI 61, Drinking Water System Components - Health Effects.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Grout Testing Laboratory:

a. Independent testing laboratory employed for design and testing of grout materials and mixes shall comply with testing laboratory requirements in Section 03 30 00, Cast-in-Place Concrete and other applicable requirements in the Contract Documents.

2. Manufacturer: Shall have a minimum of five years experience of producing products substantially similar to that required and shall be able to submit documentation of at least five satisfactory installations that have been in successful operation for at least five years each.

3. Manufacturer's Field Service Technician: When required, provide services of manufacturer's full-time employee, factory-trained in handling, use, and installing the products required, with at least five years of experience in field applications of the products required.

B. Trial Batch:

1. Each grout fill and construction joint grout mix proportion and design shall be verified by laboratory trial batch or field experience methods. Comply with ACI 211.1 and submit to ENGINEER a report with the following data:

a. Complete identification of aggregate source of supply.

b. Tests of aggregates for compliance with specified requirements.

c. Scale weight of each aggregate.

d. Absorbed water in each aggregate.

e. Brand, type, and composition of cement.

f. Brand, type, and amount of each admixture.

g. Amounts of water used in trial mixes.

h. Proportions of each material per cubic yard.

i. Unit weight and yield per cubic yard of trial mixtures.

j. Measured slump.

k. Measured air content.

l. Compressive strength developed at seven days and 28 days, from not less than three test specimens cast for each seven-day and 28-day test, and for each design mix.

2. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301.

3. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Schedule of Project-specific grout applications, installation locations, and the grout type proposed for each.

b. List of grout materials and proportions for the proposed mix designs. Include data sheets, test results, certifications, and mill reports to qualify the materials proposed for use in the mix designs. Do not start laboratory trial batch testing until submittal is approved by ENGINEER.

c. Trial Batch Reports: Submit laboratory test reports for grout materials and mix design tests.

2. Product Data:

a. Data sheets, certifications, and manufacturer's specifications for all materials proposed for use.

B. Informational Submittals: Submit the following:

1. Manufacturer’s Instructions:

a. Special instructions for shipping, storing, protecting, and handling.

b. Installation instructions for the materials.

2. Supplier Reports:

a. Submit written report of results of each visit to Site by Supplier’s field service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.

3. Qualifications Statements:

a. Testing laboratory, when not submitted under other Sections.

b. Manufacturer, when submittal of qualifications is required by ENGINEER.

c. Manufacturer's field service technician, when submittal of qualifications is required by ENGINEER.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Storage of Materials: Store grout materials in a dry location, protected from weather and protected from moisture.

PART 2 PRODUCTS

2.01 GENERAL

A. All grout materials, admixtures, cementitious materials, and other materials used in grout that contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

2.02 NON-SHRINK GROUT MATERIALS

A. General: Non-shrink grout shall be a prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or container in which the materials are packaged. Specific formulation for each type or class of non-shrink grout specified in this Section shall be that recommended by the grout manufacturer for the particular application.

B. Class I Non-Shrink Grout:

1. Class I non-shrink grouts shall have a minimum 28-day compressive strength of 7,000 psi. Use grout for precision grouting and where water-tightness and non-shrink reliability in both plastic and hardened states is critical, in accordance with Table 03 60 00-A in this Section.

2. Products and Manufacturer: Provide one of the following:

a. MasterFlow 928, by Master Builders, Inc.

b. Five Star Grout, by Five Star Products, Inc.

c. Hi-Flow Grout, by Euclid Chemical Company.

d. Or equal.

3. Comply with ASTM C1107/C1107M, Grade C and B (as modified below) when tested using amount of water required to achieve the following properties:

a. Fluid consistency (20 to 30 seconds) shall be in accordance with ASTM C939.

b. At temperatures of 45, 73.4, and 95 degrees F.

4. Length change from placing to time of final set shall not have shrinkage greater than the expansion measured at three or fourteen days. Expansion at three or fourteen days shall not exceed the 28-day expansion.

5. Non-shrink property shall not be based on chemically-generated gas or gypsum expansion.

6. Fluid grout shall pass through the flow cone, with continuous flow, one hour after mixing.

C. Class II Non-Shrink Grout:

1. Class II non-shrink grouts shall have minimum 28-day compressive strength of 7,000 psi. Use grout for general-purpose grouting applications in accordance with Table 03 60 00-A in this Section.

2. Products and Manufacturer: Provide one of the following:

   a. MasterFlow 100, by Master Builders, Inc.

   b. FSP Construction Grout, by Five Star Products, Inc.

   c. NS Grout, by Euclid Chemical Company.

   d. Or equal.

3. Comply with ASTM C1107/C1107M and the following when tested using the quantity of water required to achieve the following properties:

   a. Flowable consistency (140 percent flow in accordance with ASTM C230/C230M, five drops in 30 seconds).

   b. Fluid working time of at least 15 minutes.

   c. Flowable for at least 30 minutes.

4. When tested, grout shall not bleed at maximum allowed water.

5. Non-shrink property shall not be based on chemically-generated gas or gypsum expansion.

D. Class III Non-Shrink Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100-percent solids system.

2. Products and Manufacturer: Provide one of the following:

   a. E3G, by Euclid Chemical Company.

   b. Sikadur 42 Grout Pak LE, by Sika Corporation.

c. HP Epoxy Grout, by Five Star Products, Inc.

d. Or equal.

3. Epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all pre-measured and prepackaged. Resin component shall not contain non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are unacceptable. Variation of component ratios is not allowed without specific recommendation by manufacturer. Manufacturer's instructions shall be printed on each container in which products are packaged.

4. The following properties shall be attained with the minimum quantity of aggregate allowed by epoxy grout manufacturer.

   a. Vertical volume change at all times before hardening shall be between zero percent shrinkage and 4.0 percent expansion when measured in accordance with ASTM C827 (modified for epoxy grouts by using an indicator ball with specific gravity between 0.9 and 1.1).

   b. Length change after hardening shall be less than 0.0006-inch per inch and coefficient of thermal expansion shall be less than 0.00003-inch per inch per degree F when tested in accordance with ASTM C531.

   c. Compressive creep at one year shall be less than 0.001-inch per inch when tested under a 400-psi constant load at 140 degrees F in accordance with ASTM C1181.

   d. Minimum seven-day compressive strength shall be 14,000 psi when tested in accordance with ASTM C579

   e. Grout shall be capable of maintaining at least a flowable consistency for minimum of 30 minutes at 70 degrees F.

   f. Shear bond strength to portland cement concrete shall be greater than shear strength of concrete when tested in accordance with ASTM C882/C882M.

   g. Minimum effective bearing area shall be 95 percent.

2.03 GROUT MATERIALS OTHER THAN NON-SHRINK GROUT

A. General: Materials for grouts (other than non-shrink grouts) shall be in accordance with Section 03 30 00, Cast-In-Place Concrete, except as otherwise specified in this Section.

B. Grout Fill:

1. Grout fill shall be comprised of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed in accordance with this Section.

   a. Minimum Compressive Strength: 4,000 psi at 28 days.

b. Maximum Water-Cement Ratio: 0.45 by weight.

c. Coarse Aggregate: ASTM C33/C33M, No. 8 size.

d. Fine Aggregate: ASTM C33/C33M, approximately 60 percent by weight of total aggregate.

e. Air Content: Seven percent (plus or minus one percent).

f. Minimum Cement Content: 564 pounds per cubic yard.

g. Slump for grout fill shall be adjusted to match placing and finishing conditions, and shall not exceed four inches.

C. Construction Joint Grout:

1. Construction joint grout shall be comprised of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned with similar cementitious characteristics as Class "A" concrete specified in Section 03 30 00, Cast-In-Place Concrete. Mix design shall result in grout that is flowable with high mortar content. Mix requirements are:

a. Minimum Compressive Strength: 4,500 psi at 28 days.

b. Maximum Water-Cement Ratio: 0.42 by weight.

c. Coarse Aggregate: ASTM C33/C33M, No. 8 size.

d. Fine Aggregate: ASTM C33/C33M, approximately 60 percent by weight of total aggregate.

e. Air Content: Seven percent (plus or minus one percent).

f. Minimum Cement Content: 752 pounds per cubic yard.

g. Slump for Construction Joint Grout: Seven inches (plus or minute one inch).

D. Filter Underdrain Blocks Grout:

1. Grout shall comply with Article 2.1 of this Section. Grout shall consist of one part cement to two parts sand with shrinkage-reducing admixture. Class I or Class II non-shrink grout may be used in lieu of filter underdrain blocks grout.

a. Minimum Compressive Strength: 4,000 psi at 28 days.

b. Maximum Water-Cement Ratio: 0.45 by weight.

2.04 CURING MATERIALS

A. Curing materials shall comply with Section 03 30 00, Cast-in-Place Concrete, and shall be as recommended by the manufacturer of prepackaged grouts.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine substrate and conditions under which grouting will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. General:

1. Place grout as shown and indicated, and in accordance with Laws and Regulations and grout manufacturer's instructions. If manufacturer's instructions conflict with the Contract Documents, obtain clarification or interpretation from ENGINEER before proceeding.

2. Consistency of non-shrink grouts shall be as required to completely fill the space to be grouted for the particular application. Do not install grout for dry-packing without approval of ENGINEER. When dry-packing is approved by ENGINEER, dry-pack consistency shall be such that grout has sufficient water to ensure hydration and grout strength development, and remains plastic, moldable, and that does not flow.

3. Grouting shall comply with temperature and weather limitations in Section 03 30 00, Cast-In-Place Concrete.

4. Cure grout in accordance with grout manufacturer’s instructions for prepackaged grout and Section 03 30 00, Cast-In-Place Concrete, for grout fill.

B. Columns and Beams:

1. After shimming columns and beams to proper elevation, securely tighten anchors. Properly form around base plates allowing sufficient room around edges for placing grout. Provide adequate depth between bottom of base plate and top of concrete base to assure that void is completely filled with non-shrink grout.

C. Equipment Bases:

1. Install equipment in accordance to manufacturer’s recommendations, Laws, and Regulations, and the Contract Documents. After shimming equipment to proper elevation, securely tighten anchors. Properly form around base plates, allowing sufficient room around edges for placing grout. Provide adequate depth between bottom of equipment base and top of concrete base to ensure that voids are completely filled with non-shrink grout.

D. Handrail Posts:

1. After posts have been properly inserted into holes or sleeves, fill annular space between posts and sleeve with non-shrink grout. Bevel grout at juncture with post so that water will flow away from post.

E. Construction Joints:

1. Place a six-inch minimum thick layer of construction joint grout over contact surface of concrete at interface of horizontal construction joints in accordance with Section 03 15 00, Concrete Accessories, and Section 03 30 00, Cast-In-Place Concrete.

F. Grout Fill:

1. All mechanical, electrical, and finish work shall be completed prior to placing grout fill. Base slab shall be provided with a scratched finish in accordance with Section 03 30 00, Cast-In-Place Concrete. Roughen existing slabs shall by abrasive blasting or hydroblasting exposing aggregates to ensure bonding to base slab.

2. Minimum thickness of grout fill shall be one-inch. Where finished surface of grout fill is to form an intersecting angle of less than 45 degrees with concrete surface against which grout will be placed, form a key in the concrete surface at the intersection point. Key shall be minimum of 3.5 inches wide by 1.5 inches deep.

3. Thoroughly clean and wet base slab prior to placing grout fill. Do not place grout fill until slab is completely free of standing water. A thin coat of neat Type II cement slurry shall be broomed into surface of slab. Place grout fill while slurry is wet. Grout fill shall be compacted by rolling or tamping, brought to elevation, and floated. In tanks and basins where scraping-type equipment will be installed, grout fill shall be screeded by blades attached to revolving mechanism of equipment in accordance with procedures recommended by equipment manufacturer after grout is brought to elevation.

4. Grout fill placed on sloping slabs shall be installed uniformly from bottom of slab to top, for full width of placement.

5. Test grout fill surface with a straight edge to detect high and low spots; immediately correct high and low spots in grout fill. When grout fill has hardened sufficiently, grout fill shall be steel troweled to provide a smooth surface free of bug holes and other imperfections. While an acceptable type of mechanical trowel may be used in this operation, the last pass over the grout fill surface shall be by hand-troweling. During finishing, do not apply the following to the grout fill surface: water, dry cement, or mixture of dry cement and sand.

6. Cure and protect grout fill in accordance with Section 03 30 00, Cast-In-Place Concrete.

3.03 FIELD QUALITY CONTROL

A. Field Testing Services:

1. OWNER will employ testing laboratory to perform field quality control testing for grout. ENGINEER will direct the testing requirements.

2. CONTRACTOR shall provide all curing and necessary cube storage as specified in Section 01 45 28, On-Site Facilities for Testing Laboratory.

B. Quality Control Testing During Construction:

1. Grout Fill: Perform sampling and testing for field quality control during grout fill placing as follows:

a. Sampling Fresh Grout Fill: ASTM C172.

b. Slump: ASTM C143; one test for each load of grout at point of discharge.

c. Air Content: ASTM C231; one sample for every two grout loads at point of discharge, and when a change in the grout is observed.

d. Compression Test Specimens:

1) In accordance with ASTM C109/C109M; make one set of compression cubes for each 50 cubic yards of grout, or fraction thereof, of each mix design placed each day. Each set shall be four standard cubes, unless otherwise directed by ENGINEER.

C. Evaluation of Field Quality Control Tests:

1. Do not use grout, delivered to final point of placement, having slump or total air content that does not comply with the Contract Documents.

2. Compressive strength tests for laboratory-cured cubes will be acceptable if averages of all sets of three consecutive compressive strength test results equal or exceed the required 28-day design compressive strength of the associated type of grout.

3. If the compressive strength tests do not comply with the requirements in the Contract Documents, the grout represented by such tests will be considered defective and shall be removed and replaced, or subject to other action required by ENGINEER, at CONTRACTOR's expense.

D. Manufacturer's Services:

1. Manufacturers of proprietary materials shall make available upon 72 hours notification the services of qualified, full time employee, experienced in serving as a field service technician for the products required, to aid in assuring proper use of products under the actual conditions at the Site.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 03 74 00

MODIFICATIONS TO EXISTING CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Scope of Work:

1. Furnish all labor, materials, equipment, and incidentals required and cut, remove, repair, or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.

B. Related Sections:

1. Section 03 10 00, Concrete Formwork.
2. Section 03 20 00, Concrete Reinforcement.
3. Section 03 25 10, Concrete Joints.
4. Section 03 30 00, Cast-in-Place Concrete.
5. Section 03 60 00, Grout.
6. Section 05 50 10, Miscellaneous Metal Fabrications.

1.02 QUALITY ASSURANCE

A. Referenced Standards: Comply with provisions of following codes, specifications, and standards, except as otherwise indicated.

1. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
2. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Sheer
3. ASTM D570 - Standard Test Method for Water Absorption of Plastics
4. ASTM D638 - Standard Test Method for Tensile Properties of Plastics
5. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics
6. ASTM D732 - Standard Test Method for Shear Strength of Plastics by Punch Tool
7. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

B. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer or where directed in the Drawings.

C. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing, and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust, and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown, or specified, line drilling will be required in cutting existing concrete.

D. Manufacturer Qualifications: The manufacturer of the specified products shall have a minimum of 10 years experience in the manufacture of such products and shall have an ongoing program of training, certifying, and technically supporting the Contractor's personnel.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01 33 00 Schedule of Demolition, and the detailed methods of demolition to be used at each location.

B. Submit manufacturer's technical literature on all product brands proposed for use to the Engineer for review. The submittal shall include the manufacturer's installation and/or application instructions.

C. When substitutions for acceptable brands of materials specified herein are proposed, submit brochures and technical data of the proposed substitutions to the Engineer for approval before delivery to the project.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver the specified products in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.

B. Store and condition the specified product as recommended by the manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

A. General

1. Materials shall comply with this Section and any state or local regulations.

B. Epoxy Bonding Agent

1. General

a. The epoxy bonding agent shall be a two-component, solvent-free, asbestos-free, moisture-insensitive epoxy resin material used to bond plastic concrete to

hardened concrete complying with the requirements of ASTM C881, Type V, and the additional requirements specified herein.

2. Material

a. Properties of the cured material:

1) Compressive Strength (ASTM D695): 8,500 psi minimum at 28 days

2) Tensile Strength (ASTM D638): 4,000 psi minimum at 14 days

3) Flexural Strength (ASTM D790 - Modulus of Rupture): 6,300 psi minimum at 14 days

4) Shear Strength (ASTM D732): 5,000 psi minimum at 14 days

5) Water Absorption (ASTM D570 - 2 hour boil): 1 percent maximum at 14 days

6) Bond Strength (ASTM C882) Hardened to Plastic: 1,500 psi minimum at 14 days moist cure

7) Color: Gray

3. Approved manufacturer's include: Sika Corporation, Lyndhurst, New Jersey - Sikadur 32, Hi-Mod; Master Builder's, Cleveland, Ohio - Concresive Liquid (LPL); or W.R. Meadows.

C. Epoxy Paste

1. General

a. Epoxy Paste shall be a two-component, solvent-free, asbestos free, moisture insensitive epoxy resin material used to bond dissimilar materials to concrete such as setting railing posts, dowels, anchor bolts, and all-threads into hardened concrete and shall comply with the requirements of ASTM C881, Type I, Grade 3, and the additional requirements specified herein.

2. Material

a. Properties of the cured material:

1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days

2) Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break - 0.3 percent minimum

3) Flexural Strength (ASTM D790 - Modulus of Rupture): 3,700 psi minimum at 14 days

4) Shear Strength (ASTM D732): 2,800 psi minimum at 14 days

5) Water Absorption (ASTM D570): 1.0 percent maximum at 7 days

6) Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure

7) Color: Concrete grey

3. Approved manufacturer's include:

a. Overhead applications: Sikadur Hi-mod LV 31, Sika Corporation, Lyndhurst, New Jersey; Concresive 1438, Master Builders, Inc., Cleveland, Ohio; or W.R. Meadows.

b. Sikadur Hi-mod LV 32, Sika Corporation, Lyndhurst, New Jersey; Concresive 1438, Master Builders, Inc., Cleveland, Ohio; or W.R. Meadows.

D. Non-Shrink Precision Cement Grout, Non-Shrink Cement Grout, and Non-Shrink Epoxy Grout are included in Section 03 60 00, Grout.

E. Repair Mortars: See Section 03 93 00.

PART 3 EXECUTION

3.01 GENERAL

A. Cut, repair, reuse, demolish, excavate, or otherwise modify parts of the existing structures or appurtenances, as indicated on the Drawings, specified herein, or necessary to permit completion of the Work. Finishes, joints, reinforcements, sealants, etc., are specified in respective Sections. All work shall comply with other requirements of this of Section and as shown on the Drawings.

B. All commercial products specified in this Section shall be stored, mixed, and applied in strict compliance with the manufacturer's recommendations.

C. In all cases where concrete is repaired in the vicinity of an expansion joint or control joint the repairs shall be made to preserve the isolation between components on either side of the joint.

D. When drilling holes for dowels/bolts at new or existing concrete, drilling shall stop if rebar is encountered. As approved by the Engineer, the hole location shall be relocated to avoid rebar. Rebar shall not be cut without prior approval by the Engineer. Where possible, rebar locations shall be identified prior to drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

3.02 CONCRETE REMOVAL

A. Concrete designated to be removed to specific limits as shown on the Drawings or directed by the Engineer, shall be done by line drilling at limits followed by chipping or jack-hammering as appropriate in areas where concrete is to be taken out. Remove concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in place equipment is not damaged. Sawcutting at limits of concrete to be

removed shall only be done if indicated on the Drawings, or after obtaining written approval from the Engineer.

B. Where existing reinforcing is exposed due to saw cutting/core drilling and no new material is to be placed on the sawcut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a thickness of 1/2-in. Rebar shall be drilled and grinded to establish minimum cover requirements prior to application of the surface treatment as detailed in the Drawings.

C. In all cases where the joint between new concrete or grout and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the joint shall be grooved and grouted after the new concrete placement has fully cured as directed in the Drawings.

D. Concrete specified to be left in place that is damaged shall be repaired by approved means to the satisfaction of the Engineer.

E. The Engineer may from time to time direct the Contractor to make additional repairs to existing concrete. These repairs shall be made as specified or by such other methods as may be appropriate.

F. All demolished concrete and other demolished materials shall be removed offsite by the Contractor.

3.03 CONNECTION SURFACE PREPARATION

A. Connection surfaces shall be prepared as specified below for concrete areas requiring patching, repairs or modifications as shown on the Drawings, specified herein, or as directed by the Engineer.

B. Remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by dry mechanical means, i.e., sandblasting, grinding, etc., as approved by the Engineer. Be sure the areas are not less than 1/2-in in depth. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete, subject to final inspection.

C. If reinforcing steel is exposed, it must be mechanically cleaned to remove all contaminants, rust, etc., as approved by the Engineer. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1-in. Reinforcing to be saved shall not be damaged during the demolition operation.

D. Reinforcing from existing demolished concrete that is shown to be incorporated in new concrete shall be cleaned by mechanical means to remove all loose material and products of corrosion before proceeding with the repair. It shall be cut, bent, or lapped to new reinforcing as shown on the Drawings and provided with 1-in minimum cover all around.

E. The following are specific concrete surface preparation "methods" to be used where called for on the Drawings, specified herein, or as directed by the Engineer. Adhesive doweling shall be in accordance with Section 03 20 00.

1. Method A: After the existing concrete surface at connection has been roughened and cleaned, thoroughly moisten the existing surface with water. Brush on a 1/16-in layer of cement and water mixed to the consistency of a heavy paste. Immediately after application of cement paste, place new concrete or grout mixture as detailed on the Drawings.

2. Method B: After the existing concrete surface has been roughened and cleaned, apply epoxy bonding agent at connection surface. The field preparation and application of the epoxy bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or grout mixture to limits shown on the Drawings within time constraints recommended by the manufacturer to ensure bond.

3. Where no method is specified, Method B shall be used.

END OF SECTION

SECTION 04 05 00

MORTAR AND GROUT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to the work in this section.

1.02 WORK INCLUDED

Mortar and grout for masonry construction.

1.03 RELATED WORK

A. Section 01 45 00 – Testing and Laboratory Services.

B. Section 04 22 00 – Concrete Masonry Units.

1.04 REFERENCES

A. ACI 530 – Building Code Requirements for Masonry Structures.

B. ACI 530.1 – Specifications for Masonry Structures.

C. ASTM C5 – Specification for Quicklime for Structural Purposes.

D. ASTM C144 – Aggregate for Masonry Mortar.

E. ASTM C150 – Portland Cement.

F. ASTM C207 – Hydrated Lime for Masonry Purposes.

G. ASTM C270 – Mortar for Unit Masonry.

H. ASTM C404 – Aggregate for Masonry Grout.

I. ASTM C476 – Grout for Reinforced and Non-Reinforced Masonry.

J. ASTM C780 – Test Method for Evaluation of Mortars.

K. ASTM C952 – Testing of Mortar Bond Strength.

L. ASTM C1072 – Method for Measurement of Masonry Flexural Bond Strength.

M. ASTM C1142 – Ready Mixed Mortar for Masonry.

1.05 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Design Mix and Admixtures.

C. Samples of mortar illustrating mortar color and range of color.

D. Reports: Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.

E. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Manufacturer's Installation Instructions: Submit packaged dry mortar manufacturer's installation instructions.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with ACI 530 and ACI 530.1.

1.07 TESTING

A. As specified in Section 01 45 00.

B. Per ASTM C780 for Mortar.

C. Per ASTM C143 for Grout.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products under provisions of Section 01 60 00.

B. Maintain packaged materials clean, dry and protected against dampness, freezing and foreign matter.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather: Maintain materials and surrounding air temperature to minimum 40°F prior to, during and 48 hours after completion of masonry work.

B. Hot Weather: Maintain materials and surrounding air temperature to 90°F prior to, during and 48 hours after completion of masonry work.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150, normal-Type I.

B. Mortar Aggregate: ASTM C144, standard masonry type, clean, dry, protected against dampness, freezing, and foreign matter.

C. Grout Course Aggregate: ASTM C404.

D. Hydrated Lime: ASTM C207, Type S.

E. Water: Clean and potable.

F. Water Repellent Additive: "Mortar Tite" integral admixture for water repellent mortar by Addiment, Inc.or Krete Guard Mortar Mix by Krete.

G. Mortar Color: An approved brand, pure, non-fading, mineral pigment color as submitted by the Contractor and selected by Architect. A different color may be used with each type and color of masonry.

H. Substitutions under provisions of Section 01 60 00.

2.02 MORTAR MIXES

A. Allowable mortar mix ranges for proportions of mortar for masonry by volume per ASTM C270 types.

1. Mortar for exterior masonry veneer walls:
   -1-part Portland cement
   -1/2-part hydrated lime (1-part)
   -Sand not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials
   -Incorporate "Mortar Tite" per label instructions.
2. Mortar for structural walls (Type S):
   -1-part Portland cement
   -1/2-part hydrated lime
   -Sand not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials.
   -Incorporate "Mortar Tite" per label instructions for exterior walls and Glazed CMU walls in

B. Provide cement-lime mortar; masonry cement is not acceptable.

C. Color as selected by Architect.

2.03 GROUT MIXES

A. Shall be in accordance with ASTM C476.

B. Grout Mix Designs:
1. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C94/C94M.
2. Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C94/C94M.

C. Unless noted otherwise, 2500 PSI Strength
D. Testing: In accordance with ASTM C1019.

2.04 MORTAR MIXING

A. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use between three and five minutes with the maximum amount of water to produce a workable consistency in a mechanical batch mixer.

B. If water is lost by evaporation, re-temper within 2 hours of mixing. Do not re-temper mortar after 2 hours of mixing.

C. GROUT MIXING: Comply with ASTM C476 for grout of consistency at time of placement that will completely fill all spaces intended to receive grout.

2.05 MORTAR STRENGTH

Type S Mortar shall have a minimum 28-day compressive strength of 1800 PSI.

2.06 PRECONSTRUCTION TESTING

A. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing. Test results will be used for establishing optimum mortar proportions and establish quality control values for construction testing.

B. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install mortar and grout in accordance with ASTM C270.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not install grout in lifts greater than 16” without consolidating grout by rodding.

D. Do not displace reinforcement while placing grout.

E. Remove excess mortar from grout spaces.

F. Mortar color shall be consistent throughout the project or will be rejected.

G. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.

H. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 45 00.

B. Test and evaluate mortar in accordance with ASTM C780.

C. Test and evaluate grout in accordance with ASTM C1019.

END OF SECTION

SECTION 04 05 23

MASONRY ACCESSORIES - FLASHING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. Provide "TotalFlash", or approved equal, all-inclusive flashing/drainage system. System includes Flashing, Cavity Wall Drainage, Drip Edge, Termination Bar and Weeps.

B. Related Sections:

1. Section 04 22 00 – Concrete Masonry Units

1.03 REFERENCES

A. Industry Standards:
1. ASTM
2. BIA
3. MCAA

B. Industry Standards:

1. BIA Tech Note: Brick Construction - #7
   Water Penetration Resistance - Design and Detail
2. BIA Tech Note: Brick Construction - #28B
   Brick Veneer/Steel Stud Walls

1.04 DEFINITIONS

A. Terms:

1. Cavity Wall Flashing
2. Foundation Sill Flashing
3. Through Wall Flashing
4. Termination Bar
5. Adhesive/Sealant for Flashing

1.05 SUBMITTALS

A. Provide in accordance with Section 01 33 00 (Submittal Procedures)

1. Product data and installation instructions.
2. Two sections demonstrating lap joint: Each 18" x 14" (457 mm x 356 mm)

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Mortar Net USA Ltd, 541 S. Lake Street, Gary, IN 46403
Ph: 800-664-6638 www.MortarNet.com
Local representative: RK HOLMES COMPANY, (Jeff Holmes) 817-845-4465

B. Substitutions: Under provisions at Section 01 60 00

2.02 PRODUCTS

TotalFlash system consists of: Thermoplastic Vinyl Membrane, manufactured by Mortar Net.; Mortar Net Drainage/Weep System, Mortar Net Stainless Steel Drip Edge, and Mortar Net Termination Bar.

A. TotalFlash System: The Thermoplastic Vinyl Membrane is a 40-mil polymeric, reinforced, UV stable membrane. TotalFlash system shall be provided in minimum 12" x 5' panels and pre molded inside and outside corner pieces.

B. Mortar Collection Device/Weep Tabs: Recycled polyester material impregnated with UV protection, biocide to resist mold and flame retardant. Woven mesh designed to allow moisture to migrate to the integrated weep tabs; product adhered to the flashing membrane. Color to match masonry and be approved by Architect.

1. Thickness: 3/8 inch (9.25 mm)
2. Height: 10 inches (254 mm)
3. Length: 5 feet (1524 mm)

C. Drip Edge (used along brick ledge): 304 Stainless Steel Drip Edge pre-attached to the flashing membrane and designed to divert moisture away from the masonry wall.

1. 28-gauge (.014) 304 Stainless Steel with formed drip edge
2. Length: 5 feet (1524 mm)
3. Width: 2.0 inches (51mm)

Provide Total Flash system without the stainless-steel Drip Edge as shown and detailed on the Construction Documents above areas where the first masonry course is fully grouted and where Total Flash is used except along the brick ledge. The Total Flash System without the Drip Edge should come from the manufacturer and not removed in the field.

D. Adhesive: Provided with system for lapping TotalFlash sections:

a. Multi-Purpose/Structural Sealant/No Slump/Moisture Cure (Exceeds ASTM C920-94)

b. NO VOC
c. One part

E. Termination Bar: Pre-attached termination bar is designed to fasten flashing system to the substrate or can be tucked into mortar joint.

a. Strip manufactured from high strength corrosion resistance plastic with pre-drilled holes for attachment.
b. Length 5 feet (1524 mm)
c. Hole spacing 6 inches (152 mm)

F. Screws: Provided self-tapping hex head screws designed to allow attachment to Masonry, Wood or Steel Stud.

1. #14 x 1-1/4
2. Minimum 5-foot section

G. Block Flash & BlockNet:

1. Provide Block Flash by MortarNet at all unfilled cells in single wythe block above solid horizontal rows such as lintels.
2. Provide BlockNet with stainless steel drip along the foundation at single wythe walls.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install Flashing/Drainage System in accordance with Manufacturer's installation instructions.

B. Install system as required by detailed project drawings for cavity wall drainage.

C. Provide flashing membrane system and drainage mat above all openings unless otherwise approved by Architect. The drip edge is not used above the openings, as it is intended to be used along the masonry ledge.

D. Block Net shall be installed flush with the exterior wall and will not function properly if it is too far in or out from the face. Provide a video of an on-site. Water test after going up 4 courses to show that it will drain properly.

E. Provide written field report from manufacturer representative indicating their on-site visual observation during installation, confirming proper installation.

END OF SECTION

SECTION 04 22 00
CONCRETE MASONRY UNITS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.
9. Cavity-wall insulation.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete".
2. Section 051200 "Structural Steel" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Section 055000 "Miscellaneous Metal " for furnishing steel lintels and shelf angles for unit masonry.
4. Section 076200 "Sheet Metal Flashing and Trim".
5. Section 04 05 23 Masonry Accessories – Flashing
6. Section 07 92 00 Joint Sealant

1.03 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:

1. Exposed and Decorative CMUs.
2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep holes and vents.
4. All masonry Accessories including flashing.

1.06 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.
   a. Include data on material properties, material test reports substantiating compliance with requirements.
   b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
   c. For exposed brick, include test report for efflorescence according to ASTM C 67.

   d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellant used in CMUs.
3. Cementitious materials. Include brand, type, and name of manufacturer.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.07 MOCKUPS

A. Concrete Masonry Unit Mockup:
1. Provide mockups as directed by the Architect.
2. As soon as the samples have been approved, deliver enough units to the job site to construct:
   a. Sample wall panel as indicated in the Drawings.. Note that Interior walls shall be constructed for exposed to view on both sides. Provide sample of each condition including burnished units when used for specific projects, interior walls and each exterior wall system. Include back up wall (studs or CMU), sheathing, flashings, damp proofing, mortar net and weeps, caps, sills, insulation, etc. Where windows are indicated in a CMU wall, install one min 12”x12” aluminum frame system.
3. Construct the panel using the mortar, reinforcing, tooling and cleaning as specified.
4. The approved sample panel shall be the standard of workmanship.
5. Panel shall not be removed until masonry work as required by this section has been accepted or as directed by the Architect.
6. Use sample panel to test cleaning methods.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24” down both sides of walls and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24” down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that meet such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Do not build on frozen work
2. Before erecting masonry during temperatures below 40 degrees F, a written statement shall be submitted and approved received of the methods proposed to heat the masonry materials and protect the masonry from freezing as required below.
3. Masonry units shall be kept completely covered and free from frost, ice, and snow at all times. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
4. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 – PRODUCTS

2.01 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: As indicated in Drawings.
2. Density Classification: Normal weight.
3. Size, Nominal (8”x8”x16” or as indicated on drawings): Manufactured to dimensions 3/8” less than nominal dimensions.
4. Exposed Faces: Manufacturer's standard color and texture. Double face units shall have the same texture on both sides and shall be the same texture as adjacent units whether the front face is split face, burnished face, or normal (smooth) face. All masonry exposed to view from the exterior shall have integral color and water repellent.

D. Decorative CMUs (glazed, textured, burnished, split or others): ASTM C 90.

1. Unit Compressive Strength: As indicated in Drawings.
2. Density Classification: Normal weight.
3. Size, Nominal (8”x8”x16” & 4”x8”x16” or as indicated on drawings): Manufactured to dimensions 3/8” less than nominal dimensions.
4. Pattern and Texture:
   a. Standard pattern, burnished finish. Exposed Faces: Manufacturer's standard color and texture. Colors will be selected during construction from the manufacture’s colors in the Standard and Vari-tone color selections (S and V colors) unless otherwise indicated on the drawings.
6. Colors: As indicated on drawings:

2.03 MASONRY LINTELS

A. Masonry Lintels: Built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

2.04 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

E. Mortar Cement: ASTM C 1329.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

G. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4" thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C 404.

I. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

J. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.

K. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Euclid Chemical Company (The); Accelguard 80.
   b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
   c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

L. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, Mortar Tite by Addiment, or the following
   a. ACM Chemistries; RainBloc for Mortar.
   b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
   c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

M. Water: Potable.

2.05 REINFORCEMENT

A. Provide reinforcing as indicated on Drawings.

2.06 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
4. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
6. Stainless-Steel Sheet: ASTM A 666, Type 304.
7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
8. Stainless-Steel Bars: ASTM A 276 or ASTM a 666, Type 304.

B. Corrugated Metal Ties: Metal strips not less than 7/8” wide with corrugations having a wavelength of and an amplitude of 0.06 to 0.10” made from 0.060”- thick, steel sheet, galvanized after fabrication. Use only where Individual ties and adjustable anchors will not work.

C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8” cover on outside face. Outer ends of wires are bent 90 degrees and extend 2” parallel to face of veneer.

D. Individual Wire Ties: Rectangular units with closed ends and not less than 4” wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2” long may be used for masonry constructed from solid units.
2. Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4”.

3. Wire: Fabricate from 1/4”- diameter, hot-dip galvanized steel.

E. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4”- diameter, hot-dip galvanized steel wire.

F. Adjustable Anchors for Connecting to Stone: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.109”- thick, stainless-steel sheet.

2.07 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034”, galvanized steel sheet.

C. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

D. Post-installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.08 FLASHING MATERIALS

A. Flashing: Use one of the following unless otherwise indicated:

1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040” (1.02 mm) thick.
2. Mortar Net: High-density polyethylene (HOPE), 90% open mesh, dovetail shape. Size as required to fill cavity opening.

3. BlockNet by Mortar Net for all exterior single wythe masonry walls along foundation. Installed per mfr recommendations, and Block Flash for single wythe wall above solid filled courses such as bond beams and lintels and as required in Section 04 05 23.
4. Weeps: Weeps shall be formed with weep tabs as part of the Total Flash system.
5. Flashing: As per Section 04 05 23 and 07 62 00.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counter flashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
4. Where flashing is fully concealed, use metal flashing.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.09 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use one of the following unless otherwise indicated in 04 05 23:

1. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2” long.
2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8” less than depth of outer wythe, in color selected from manufacturer's standard.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Advanced Building Products Inc.; Mortar Maze weep vent.
      2) Blok-Lok Limited; Cell-Vent.
      3) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
      4) Heckmann Building Products Inc.; No. 85 Cell Vent.
      5) Hohmann & Barnard, Inc.; Quadro-Vent.
      6) Wire-Bond; Cell Vent.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
   a. Mortar Net USA, Ltd.; Mortar Net.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148" steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
   b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
   c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
   d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Diedrich Technologies, Inc.
   b. EaCo Chem, Inc.
   c. ProSoCo, Inc.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Refer to General Notes Section IV on Sheet S0.1.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Mix to match Architect's sample.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry where applicable on certain projects: Match coursing, bonding, color, and texture of existing masonry.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2” or minus 1/4”.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2”.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4” in a story height or 1/2” total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4” in 10’, or 1/2” maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8” in 10’, 1/4” in 20’, or 1/2” maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4” in 10’, 3/8” in 20’, or 1/2” maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8” in 10’, 1/4” in 20’, or 1/2” maximum.
5. For lines and surfaces do not vary from straight by more than 1/4” in 10’, 3/8” in 20’, or 1/2” maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4” in 10’, or 1/2” maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16” except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8”, with a maximum thickness limited to 1/2”.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8”.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8” or minus 1/4”.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8”. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8”.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16” from one masonry unit to the next.

3.04 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets.

Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4” horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24” under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

H. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
5. Along wall of kennels where resting benches are anchored into wall, bottom courses of masonry shall be completely grouted solid.

B. Set stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.

3. Wet joint surfaces thoroughly before applying mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.06 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft of wall area spaced not to exceed 24" o.c. horizontally and 16" o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12" of openings and space not more than 36" apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24" o.c. vertically.
2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
   a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
   b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
3. Header Bonding: Provide masonry unit headers extending not less than 3" into each wythe. Space headers not over 8" clear horizontally and 16" clear vertically.
4. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12" o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks/joints and open gaps in insulation with crack sealer or tape/bed compatible with insulation and masonry.

3.07 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8" on exterior side of walls, 1/2" elsewhere. Lap reinforcement a minimum of 6".

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

3.08 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2" wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24" o.c. vertically and 36" o.c. horizontally.

3.09 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
3. Space anchors as indicated, but not more than 16" o.c. vertically and 32" o.c. horizontally with not less than 1 anchor for each 3.5 sq. ft of wall area. Install additional anchors within 12" of openings and at intervals, not exceeding 36", around perimeter.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12" for brick-size units and 24" for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8" at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8", and through inner wythe to within 1/2" of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2" on interior face.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24" o.c. unless otherwise indicated.
3. Where exterior veneer wall extends down past finished grade (like at sidewalks that are sloped up to FF at entrances) grout bottom cell solid and place flashing and weeps above first course. Extend solid grouted bottom cell to a distance of 12" past where the bottom course brick shelf is exposed above grade.

F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.13 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60". Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2" below top course of pour.

3.14 OPENINGS AND HOLES

A. Provide all openings and holes in masonry work. Provide all chases and recesses in masonry work of all types as indicated on the drawings and as required for pipes, ducts, and other work of Mechanical and Electrical Contractors. Such work shall be accurately located by the Contractor requiring the work, but masonry work shall not be constructed without giving other Contractors due notice and opportunity to lay out or install such items as may be required for their work.

B. Where required for installation of work of other Contractors, leave openings as indicated on the drawing or as required to receive a later installation.

C. After work of other Contractors is in place, openings shall be neatly filled with masonry of the same type as in the adjoining surfaces.

3.18 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

3.19 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
6. Clean stone trim to comply with stone supplier's written instructions.

3.20 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 05 33

ANCHOR SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.

2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ACI 318, Building Code Requirements for Structural Concrete.

2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.

3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.

4. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

5. ASTM A276, Specification for Stainless Steel Bars and Shapes.

6. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.

7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.

8. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

9. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

10. ASTM C307, Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.

11. ASTM C579, Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

12. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

13. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.

14. ASTM D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

15. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

16. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.

17. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

18. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

19. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.

20. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).

21. FS A-A-1923A, Concrete Expansion Anchors.

22. FS A-A-1925A, Shield, Expansion (Nail Anchors).

23. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).

24. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.

25. ICC-ES AC58, Acceptance Criteria for Adhesive Anchors in Masonry Elements.

26. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.

27. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

28. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.

29. ANSI/MSS SP-58, Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.

30. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.

2. Post-installed Anchor Installer: Shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.

2. Product Data:

a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.

b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.

B. Informational Submittals: Submit the following:

1. Certificates:

a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.

b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.

2. Manufacturer's Instructions:

a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).

3. Field Quality Control Submittals:

a. Submit results of field quality control testing and inspections performed by testing laboratory.

1.05 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Keep materials dry during delivery and storage.

2. Store adhesive materials within manufacturer's recommended storage temperature range.

3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. General:

1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.

2. Stainless Steel Nuts:

a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.

b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.

3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:

a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.02A of this Section. For

conditions outside limits of critical edge distance and spacing in Paragraph 3.02A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.02A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.

b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.

1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.

2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.

3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.

4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.

5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.

6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by ENGINEER, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.

2. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:

    a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.

    b. Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.

    c. Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.

    d. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents.

C. Application:

1. Anchor Bolts:

    a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.

    b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.

2. Concrete Adhesive Anchors:

    a. Use where adhesive anchors are shown or indicated for installation in concrete.

    b. Suitable for use where subject to vibration.

    c. Suitable for use in exterior locations or locations subject to freezing.

    d. Suitable for use in submerged, intermittently submerged, or buried locations.

    e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.

f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

3. Grout-filled Concrete Masonry Adhesive Anchors:

   a. Use where adhesive anchors are shown or indicated for installation in grout-filled concrete masonry units.

   b. Suitable for use where subject to vibration.

   c. Suitable for use in exterior locations or locations subject to freezing.

   d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

4. Hollow Concrete Masonry Adhesive Anchors:

   a. Use where adhesive anchors are shown or indicated for installation in hollow concrete unit masonry.

   b. Suitable for use where subject to vibration.

   c. Suitable for use in exterior locations or locations subject to freezing.

   d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

5. Concrete Wedge Expansion Anchors:

   a. Use where expansion anchors are shown or indicated for installation in concrete.

   b. Do not use where subject to vibration.

   c. Do not use in exterior locations or locations subject to freezing.

   d. Do not use in submerged, intermittently submerged, or buried locations.

   e. Suitable for use in overhead applications.

6. Grout-filled Concrete Masonry Wedge Expansion Anchors:

   a. Use where expansion anchors are shown or indicated for installation on the interior face of grout-filled unit masonry.

   b. Do not use where subject to vibration.

   c. Do not use in exterior locations or locations subject to freezing.

7. Hollow Concrete Masonry Sleeve Expansion Anchors:

   a. Use where expansion anchors are shown or indicated for installation in hollow concrete unit masonry or solid brick.

b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.

c. Do not use where subject to vibration.

d. Do not use in exterior locations or locations subject to freezing.

8. Drop-in Expansion Anchors:

a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.

b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.

c. Do not use where subject to vibration.

d. Do not use at submerged, intermittently submerged, or buried locations.

e. Do not use in exterior locations or locations subject to freezing.

f. Suitable for use in overhead applications.

9. Concrete Undercut Anchors:

a. Use where undercut anchors are shown or indicated for installation in concrete.

b. Suitable for use where subject to vibration.

c. Do not use in submerged, intermittently submerged, or buried locations.

d. Do not use in exterior locations or locations subject to freezing.

e. Suitable for use in overhead applications.

10. Concrete Inserts:

a. Use only where shown or indicated in the Contract Documents.

b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.

11. Drive-In Expansion Anchors:

a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.

b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.

c. Do not use in overhead applications.

12. For Use in Precast Concrete Planks:

a. To support piping or conduit six-inch diameter and smaller, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.

b. For piping greater than six-inch diameter, or to support safety-related systems, use through-bolts. Each through-bolt shall consist of threaded rod, nuts, washers, and bearing plate.

2.02 MATERIALS

A. Anchor Bolts:

1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade 36, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.

2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.

3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.

4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.

B. Concrete Adhesive Anchors:

1. General:

a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.

2. Products and Manufacturers: Provide one of the following:

a. HIT-RE 500-V3 Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.

b. SET-3G High-Strength Epoxy Adhesive, by Simpson Strong-Tie Company, Inc.

c. Or equal.

3. Adhesive:

a. Adhesive system shall use two-component adhesive mix.

b. Epoxy adhesives shall comply with physical requirements of ASTM C881/C881M, Type IV, Grade 2 and 3, Class A, B, and C, except gel times.

c. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308.

d. Adhesives shall have minimum bond strength and minimum design bond strength (bond strength multiplied by strength reduction factor) in accordance with Table 05 05 33-A:

TABLE 05 05 33-A:-ADHESIVE BOND STRENGTH [1,2]

Anchor	Uncracked Concrete		Cracked Concrete	
Rod Diameter / Dowel Size	Bond Strength (psi)	Design Bond Strength (psi)	Bond Strength (psi)	Design Bond Strength (psi)
3/8-inch / #3	2040	1300	1090	700
1/2-inch / #4	1920	1200	920	560
5/8-inch / #5	1830	1150	710	390
3/4-inch / #6	1760	1050	710	460
7/8inch / #7	1670	900	610	340
1-inch / #8	1650	1050	850	460
- / #9	1900	1000	800	400
1.25-inch/ #10	1580	1000	730	400

Table Notes:
1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 110 degrees F and maximum long term concrete temperature of 75 degrees F.

4. Anchor:

a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

C. Grout-filled Concrete Masonry Adhesive Anchors:

1. General:

a. Adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.

2. Products and Manufacturers: Provide one of the following:

    a. HIT-HY 150 Max Adhesive Anchoring System, by Hilti Fastening Systems, Inc.

    b. Acrylic-Tie Adhesive, by Simpson Strong-Tie Company, Inc.

    c. Or equal.

3. Adhesive:

    a. Adhesive system shall use two-component adhesive mix.

    b. Acrylate hybrid adhesives shall comply with the following:

        1) ASTM C579 compressive strength greater than 7,252 psi, or ASTM D695 compressive yield strength greater than or equal to 10,210 psi.

        2) ASTM C307 modulus of elasticity greater than 507,000 psi or ASTM D695 compressive modulus of elasticity greater than 660,800 psi.

    c. Adhesives shall have current ICC Evaluation Service Report for use in grout-filled concrete masonry, tested and assessed in accordance with ICC-ES 58.

4. Anchor:

    a. Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316 stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

D. Hollow Concrete Masonry Adhesive Anchors:

1. General:

    a. Adhesive anchors shall consist of threaded rods with a cylindrical mesh steel or plastic screen tube anchored into hollow concrete block masonry using an adhesive system.

2. Products and Manufacturers: Provide one of the following:

    a. HIT-HY 20 for Masonry Anchoring System, by Hilti Fastening Systems, Inc.

    b. Acrylic-Tie Anchoring Adhesive, by Simpson Strong-Tie Company, Inc.

    c. Or equal.

3. Adhesive:

    a. Adhesive system shall use two-component adhesive mix.

    b. Hybrid adhesives shall comply with the following:

1) ASTM D695 compressive strength, greater than 7,410 psi.

2) ASTM D790 modulus of elasticity: 0.33 x 10^6 psi or ASTM D695 compressive modulus of elasticity greater than 0.668 x10^6 psi.

c. Adhesives shall have a current ICC Evaluation Service Report for use in hollow concrete masonry as tested and assessed in accordance with ICC-ES AC58.

4. Anchor:

a. Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

5. Mesh Screen Tube:

a. Provide with mesh size, length, and diameter as specified by adhesive anchor manufacturer.

b. Mesh shall be AISI 304 stainless steel.

E. Concrete Wedge Expansion Anchors:

1. General:

a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.

2. Products and Manufacturers: Provide one of the following:

a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.

b. Or equal.

3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.

4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.

5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.

6. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic

design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

F. Grout-filled Masonry Wedge Expansion Anchors:

1. General:

   a. Grout-filled masonry wedge expansion anchors shall each consist of stud, wedge, nut, and washer.

2. Product and Manufacturers: Provide one of the following:

   a. Kwik-Bolt 3 Expansion Anchors, by Hilti Fastening Systems, Inc.

   b. Wedge-All Wedge Anchors, by Simpson Strong-Tie Company, Inc.

   c. Or equal.

3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Anchors shall be non-bottom bearing type with single-piece steel expansion clip providing 360-degree contact with base material and shall not require oversized holes for installation.

4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.

5. Other Locations: Provide AISI Type 316 stainless steel anchor, complete with nut and washer, in accordance with ASTM A276 or ASTM A493.

6. Grout-filled masonry wedge expansion anchors shall have a current ICC Evaluation Service report for use in fully-grouted concrete masonry construction when tested and assessed in accordance with ICC-ES AC01.

G. Hollow Concrete Masonry Sleeve Expansion Anchors:

1. General:

   a. Sleeve expansion anchors shall each consist of an externally threaded stud with full length expanding sleeve.

2. Products and Manufacturers: Provide one of the following:

   a. HLC Sleeve Anchors, by Hilti Fastening Systems, Inc.

   b. Dynabolt Sleeve Anchors, by ITW Red Head.

   c. Or equal.

3. Anchors shall comply with physical requirements of FS A-A-1922A. Anchors shall be non-bottom bearing type with single-piece steel expansion sleeve providing 360-

degree contact with base material, and shall not require oversized holes for installation.

4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.

5. Other Locations: Provide expansion anchors complete with nuts and washers, Type 304 stainless steel, in accordance with ASTM A276 or ASTM A493.

H. Drop-in Expansion Anchors:

1. General:

a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.

2. Products and Manufacturers: Provide one of the following:

a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.

b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.

c. Or equal.

3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.

I. Concrete Undercut Anchors:

1. General:

a. Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.

2. Products and Manufacturers: Provide one of the following:

a. HDA Undercut Anchor, by Hilti Fastening Systems, Inc.

b. DUC Ductile Undercut Anchor, by USP Structural Connectors.

c. Or equal

3. Provide concrete undercut expansion anchors in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests.

4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.

5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM B633.

6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.

7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

J. Concrete Inserts:

1. Manufacturers: Provide products of one of the following:

a. Unistrut Corporation.

b. Cooper B-Line, Inc.

c. Anvil International, Inc.

d. Or equal.

2. Spot Concrete Inserts:

a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.

3. Continuous Concrete Inserts:

a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.

4. Provide inserts with plain finish.

K. Drive-In Expansion Anchors:

1. General:

a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.

2. Products and Manufacturers: Provide one of the following:

a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.

b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.

c. Or equal.

3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.

L. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.

M. Anti-Seizing Compound:

1. Products and Manufacturers: Provide one of the following:

a. Pure Nickel Never-Seez, by Bostik.

b. Nickel-Graf, by Anti-Seize Technology.

c. Or equal.

2. Provide pure nickel anti-seizing compound.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Anchor Bolts:

1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.

2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.

3. Protect threads and shank from damage during installation and subsequent construction operations.

4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05 05 33-B:

TABLE 05 05 33-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS [1]

Bolt Diam	F1554 Grade 36	F1554
	F593 Type 316, Condition A	Grade 55

	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2]	Shear[3,4] (lb)	Tension[3] (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2]	Shear[3] (lb)	Tension[3] (lb)
1/2	6	9	1,262	2,420	8.5	12.75	1,660	3,190
5/8	7.5	11.25	2,010	3,860	10.5	15.75	2,640	5,080
3/4	9	13.5	2,974	5,720	13	19.5	3,910	7,520
7/8	10.5	15.75	4,106	7,890	15	22.5	5,400	10,390
1	12	18	5,386	10,360	17	25.5	7,090	13,450
1 1/8	13.5	20.25	6,787	13,052	19	28.5	8,930	16,580
1 1/4	15	22.5	8,617	16,572	21	31.5	11,340	20,040

Table Notes:

1. Table is based on ACI 318 and ACI 350, Appendix D, f'_c = 4000 psi. Table 05 05 33-B is not applicable to anchor bolts embedded in grouted masonry.
2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 and ACI 350, Appendix D.
3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318 and ACI 350, Appendix D.

B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:

1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:

1. Comply with manufacturer's written installation instructions and the following.

2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.

3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.

4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.

5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.

6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.

7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.

8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.

9. Limitations:

    a. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.

    b. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.

    c. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

D. Expansion Anchors:

1. Comply with expansion anchor manufacturer's written installation instructions and the following:

2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.

3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.

4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.

5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.

E. Concrete Undercut Anchors:

1. Comply with undercut anchor manufacturer's written installation instructions and the following.

2. Protect threads from damage during anchor installation.

3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.

4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.

5. Insert the anchor by hand until anchor reaches bottom of hole.

6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.

7. Verify that the setting mark is visible on the threaded rod above the sleeve.

8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.

F. Concrete Inserts:

1. Comply with concrete insert manufacturer's installation instructions.

2. Inserts shall be flush with slab bottom surface.

3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.

4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.

G. Anti-Seizing Compound:

1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.01B of this Section.

2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.03 CLEANING

A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.04 FIELD QUALITY CONTROL

A. Site Tests:

1. OWNER will employ testing agency to perform field quality tensile testing of post-installed anchors at the Site.

a. Testing shall comply with ASTM E488.

b. Test at least ten percent of all types of post-installed anchors. If one or more post-installed anchors fail the test, CONTRACTOR shall pay cost of testing, or at ENGINEER's option CONTRACTOR may arrange for testing paid by CONTRACTOR, for all post-installed anchors of same diameter and type installed on the same day as the failed anchor. If anchors installed on the same day as the failed anchor also fail the test, ENGINEER may require retesting of all anchors of the same diameter and type installed in the Work. CONTRACTOR shall be responsible for retesting costs.

c. Test post-installed anchors to 50 percent of ultimate tensile capacity of post-installed anchor. ENGINEER will direct which anchors are to be tested.

d. Apply test loads with hydraulic ram.

e. Displacement of post-installed anchors shall not exceed D/10, where D is nominal diameter of anchor being tested.

2. Correct defective Work by removing and replacing or correcting, as directed by ENGINEER.

3. CONTRACTOR shall pay for all corrections and subsequent testing required to confirm integrity of post-installed anchors.

4. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

B. Manufacturer's Services:

1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install structural steel framing, including surface preparation and shop priming.

2. Structural steel framing is the Work defined in AISC 303, Section 2, and as shown or indicated in the Contract Documents. The Work also includes:

a. Providing openings in and attachments to structural steel framing to accommodate the Work under this and other Sections, and providing for structural steel framing items such as anchorage devices, studs, and all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before structural steel framing Work.

C. Related Sections:

1. Section 03 60 00, Grouting.

2. Section 05 05 33, Anchor Systems.

3. Section 09 91 00, Painting.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. AISC 303, Code of Standard Practice for Steel Buildings and Bridges.

2. AISC 325, Steel Construction Manual.

3. AISC 360, Specification for Structural Steel Buildings.

4. ASME B46.1, Surface Texture (Surface Roughness, Waviness and Lay).

5. ASTM A6/A6M, Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.

6. ASTM A36/A36M, Specification for Carbon Structural Steel.

7. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

8. ASTM A108, Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

9. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

10. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.

11. ASTM A490, Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.

12. ASTM A500/A500M, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

13. ASTM A563, Specification for Carbon and Alloy Steel Nuts.

14. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

15. ASTM A992/A992M, Specification for Structural Steel Shapes.

16. ASTM E329, for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.

17. ASTM F436, Specification for Hardened Steel Washers.

18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

19. ASTM F959, Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.

20. ASTM F1852, Specification for “Twist off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

21. AWS D1.1/D1.1M, Structural Welding Code-Steel.

22. CMAA 74, Specifications for Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.

23. ISO 2859-1, Sampling Procedures for Inspection by Attributes -- Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-Lot Inspection.

24. ISO 4017, Hexagon Head Screws -- Product Grades A and B.

25. RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Steel Fabricator:

a. Structural steel fabricating plant shall possess current certificate from AISC stating that the fabrication facility complies with requirements for certification of "Standard for Steel Building Structures (STD)" of AISC's quality certification program. Fabricating plant shall maintain this certification throughout time of fabrication for this Project.

2. Welders and Welding Processes:

a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, Section 5, Qualification.

b. Each welder employed on or to be employed for the Work shall possess current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.

3. Surveyor:

a. Engage a registered professional land surveyor legally qualified to practice in the same jurisdiction as the Site, and experienced in providing surveying services of the kind indicated.

b. Responsibilities include but are not necessarily limited to:

1) Performing or supervising performance of field survey work to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices, before steel erection proceeds.

2) Notifying CONTRACTOR and ENGINEER in writing when surveyed Work does not comply with the Contract Documents.

3) Submit to CONTRACTOR field survey reports.

4. Testing Laboratory:

a. CONTRACTOR shall retain the services of an independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.

b. Laboratory shall comply with ASTM E329.

c. Testing laboratory shall be experienced in the types of testing required.

d. Welding inspection and welding inspector qualifications shall be in accordance with AWS D1.1/D1.1M

e. Selection of testing laboratory is subject to ENGINEER's acceptance

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures, and diagrams showing proposed sequence of erection. Shop Drawings shall not be reproductions of Contract Drawings.

b. Include complete information for fabrication of the structure's components, including but not limited to location, type, and size of bolts, details of blocks, copes and cuts, connections, camber, holes, member sizes and lengths, and other pertinent data. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld.

c. Setting drawings, templates, and directions for installing anchorage devices.

2. Product Data:

a. Manufacturer's specifications and installation instructions for products listed below.

1) High-strength bolts of each type, including nuts and washers.

2) Welding electrodes and rods.

3) Load indicator bolts and washers.

B. Informational Submittals: Submit the following:

1. Certificates.

a. Fabricator's AISC quality certification.

b. Welders' certifications.

c. Certified reports of laboratory tests on previously-manufactured, identical materials, and other data as necessary, to demonstrate compliance with the Contract Documents for the materials listed below:

1) Structural steel of each type, including certified mill reports indicating chemical and physical properties.

2) High-strength bolts of each type, including nuts and washers.

2. Supplier Instructions:

a. Installation data, handling, and storage instructions.

3. Source Quality Control Submittals:

    a. When performed or when required by ENGINEER, submit results of source quality control testing and inspections performed at the mill or shop.

4. Field Quality Control Submittals:

    a. Written field survey reports for all bearing surfaces surveyed, verifying tolerance requirements, areas out of tolerance, and corrective measures required.

5. Qualifications Statements.

    a. Land surveyor.

    b. Testing laboratory.

1.05 DELIVERY, STORAGE AND HANDLING

A. Storage:

1. Protect steel members and packaged materials from corrosion and deterioration.

2. Do not store materials in or on the building or structure in manner that may cause distortion or damage to structural steel members, building, or supporting structures.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Types:

1. W-Shapes and WT-Shapes: ASTM A992/A992M.

2. S-shapes and Channels: ASTM A572/A572M, Grade 50.

3. Hollow Structural Sections: ASTM A500/A500M, Grade B

4. Angles, Plates, and Bars: ASTM A36/A36M.

5. Steel Pipe: ASTM A53/A53M, Grade B.

B. Anchorages, Fasteners, and Connectors:

1. Anchorage Devices: Refer to Section 05 05 33, Anchor Systems.

2. Headed Stud Type Shear Connectors: ASTM A108, Grades 1010/1020, complying with AWS D1.1/D1.1M, Section 7.

3. High-Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, as follows:

a. Unless otherwise indicated, fasteners shall be quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325, Type I, nuts complying with ASTM A563C, A563DH or A194/A194M 2H, and hardened washers complying with ASTM F436. Bolts, nuts and washers shall be hot-dip galvanized where shown or indicated.

b. Use quenched and tempered alloy steel bolts, nuts and washers, complying with ASTM A490, only at locations where shown or indicated in the Contract Documents. ASTM A490 bolts shall not be galvanized.

c. Tension control bolts, when used, shall comply with ASTM F1852.

d. Compressible washer-type direct-tension indicators, when used, shall comply with ASTM F959, Type 325.

4. Threaded Rod: Provide threaded rods with heavy hexagon nuts, and hardened washers, as follows:

a. Interior and Dry Locations: Provide threaded carbon steel rods complying with ASTM A36, with heavy hex nuts complying with ASTM A563A, unless otherwise shown or indicated on the Drawings.

b. Exterior, Buried, or Submerged Locations, or When Exposed to Wastewater: Provide stainless steel threaded rods complete with washers complying with ASTM F593, AISI Type 316, Condition A, with ASTM A194/A194M, Grade 8S (nitronic 60) stainless steel nuts. Other AISI types may be used when approved by ENGINEER.

C. Electrodes for Welding: E70XX complying with AWS D1.1/D1.1M.

2.02 FABRICATION

A. Shop Fabrication and Assembly:

1. General:

a. Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC 325, the Contract Documents, and as shown on approved Shop Drawings. Provide camber in structural members as shown or indicated.

b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials for storage and minimize handling at the Site.

c. Where finishing is required, complete the assembly, including welding of units, before commencing finishing operations. Provide finish surfaces of members exposed-to-view in the completed Work that are free of markings, burrs, and other defects.

B. Connections:

1. Shop Connections:

a. Unless otherwise shown or indicated, shop connections may be welded or high-strength bolted connections. Welds shall be 3/16-inch minimum.

b. Where reaction values of beam are not shown or indicated, connections shall be detailed to support one-half the total uniform load capacity tabulated in tables contained in AISC 325 for allowable loads on beams for the associated shape, span, and steel specified for the beam.

c. Shop-welded connections shall be detailed to eliminate or minimize eccentricity in the connection.

d. End-connection angles fastened to webs of beams and girders, and the thickness of angles, size, and extent of fasteners or shop welds, shall comply with tables of "Framed Beam Connections" in AISC 325. Connections shall be two-sided, unless otherwise shown or indicated.

2. Field Connections:

a. Field connections, unless otherwise shown or indicated, shall be made with high-strength bolts, and shall be bearing-type connections.

b. Use field welding only where shown or indicated or where approved by ENGINEER.

3. High-Strength Bolted Construction:

a. Provide high-strength threaded fasteners in accordance with RCSC Specifications for Structural Joints using ASTM A325 or ASTM A490 Bolts.

b. High-strength bolt design shear values shall be as specified in AISC 325 for bolts with threads in the shear plane for bearing type connections, or as specified in this Section for slip-critical connections.

c. Bolted connections shown or indicated as "SC" shall comply with slip-critical connection requirements in RCSC Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

1) Faying surfaces shall have a Class A surface condition.

2) Slip-critical bolts shall be fully pre-tensioned to 70 percent of minimum specified tensile strength of the bolt using one of the following methods:

a) Turn of nut with matchmarking.

b) Twist-off tension control bolt (ASTM F1852).

c) Direct tension indicator washer (ASTM F959).

d. Minimum bolt diameter shall be 3/4-inch, unless otherwise shown or indicated.

4. Welded Construction: Comply with AWS D1.1/D1.1M for procedures, appearance, and quality of welds, and methods used in correcting defective welding Work.

5. Where rigid connections are required by stresses shown or indicated, provide web shear reinforcement and stiffeners in accordance with AISC 360.

C. Bracing:

1. Bracing for which stress is not shown or indicated shall have minimum two-bolt connection, or shop-welded connection of equivalent strength.

2. Vertical bracing and knee braces connecting to columns shall be on the centerline of columns, unless otherwise shown or indicated.

3. Knee braces shall be at 45-degree angle, unless otherwise shown or indicated.

4. Gussets shall be not less than 3/8-inch thick, unless otherwise shown or indicated.

D. Columns: Column shafts shall have finished bearing surface roughness not greater than 500 micro-inch in accordance with ASME B46.1, and ends shall be square within tolerances for milled ends in accordance with ASTM A6/A6M at the base and at splice lines.

E. Structural Tubing: Properly seal structural tubing to protect internal surfaces.

F. Holes and Appurtenances for Other Work:

1. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on the approved Shop Drawings. If large block-outs are required and approved, reinforce the webs to develop specified shears. Provide threaded nuts welded to framing and other specialty items as shown or indicated to receive other work.

2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.03 FINISHING

A. Surface Preparation and Shop Priming: Structural steel shall be primed in the shop. For surface preparation and shop priming requirements refer to Section 09 91 00, Painting.

2.04 SOURCE QUALITY CONTROL

A. Inspection and Testing at the Mill or Shop:

1. Perform fabricator's standard procedures for source quality control, including inspections and testing.

2. Materials and fabrication procedures shall be subject to inspection and tests in mill and shop, conducted by a qualified inspection laboratory. Such inspections and tests

do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 ERECTION

A. General: Comply with AISC 303, AISC 360, and the Contract Documents.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy-lines to achieve proper alignment of structures as erection proceeds.

C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the Work. Provide sufficient planking to comply with Laws and Regulations, and provide tightly-planked substantial floor within two stories or 30 feet, whichever is less, below each tier of steel beams on which work is performed.

D. Anchorage Devices:

1. Provide anchorage devices, including anchor bolts, and other connectors required for securing structural steel to foundations and other in-place construction.

2. Provide templates and other devices necessary for presetting anchorage devices to accurate locations.

3. Refer to Section 05 05 33, Anchor Systems, for anchorage requirements.

E. Setting Bases and Bearing Plates:

1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

2. Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices.

3. Tighten anchorage devices after supported members are positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

4. Place grout between bearing surfaces and bases or plates in accordance with Section 03 60 00, Grouting. Finish exposed surfaces, protect installed materials, and allow to cure in accordance with grout manufacturer's instructions, and as otherwise required.

5. Do not use leveling plates or wood wedges.

F. Field Assembly:

1. Set structural frames accurately to the lines and elevations shown and indicated. Align and adjust the various members forming part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

2. Level and plumb individual members of structure within tolerances as specified in AISC 325. For members requiring accurate alignment, provide clip angles, lintels, and other members, with slotted holes for horizontal adjustment at least 3/8-inch in each direction, or more when required.

3. Splice members only where shown or indicated.

G. Erection Bolts: On exposed-to-view, welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

H. Connections:

1. Comply with AISC 325 for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

2. Do not enlarge inadequate holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

I. Gas Cutting: Do not use gas-cutting torches for correcting fabrication defects in structural framing. Cutting will be allowed only on secondary members that are not under stress, as approved by ENGINEER. Finish gas-cut sections equal to a sheared appearance, when allowed.

J. Touch-up Painting:

1. Unless otherwise specified, comply with touch-up painting requirements in Section 09 91 00, Painting.

2. Immediately after erection, clean field welds, bolted connections, and damaged or abraded areas of shop-applied paint. Apply paint to exposed areas with the same paint or coating material applied in the shop. Apply by brush or spray to provide not less than the dry film thickness specified in Section 09 91 00, Painting.

3.03 FIELD QUALITY CONTROL

A. Site Tests and Inspections: Materials and erection procedures shall be subject to inspection and tests at the Site conducted by qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.

1. OWNER will engage independent testing and inspection laboratory to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

a. Testing laboratory shall conduct and interpret tests, prepare and state in each report of results whether test specimens comply with the Contract Documents and specifically indicate all deviations.

b. High-strength Bolted Connections: Each high-strength bolted connection shall be visually inspected. Inspection shall identify whether the Work complies with Sections 2, 3, and 8 of RCSC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

1) For connections that are slip-critical or subject to axial tension, inspector shall verify proper pre-tensioning.

2) For connections that are not slip critical and not subject to direct tension, bolt does not need to be inspected for bolt tension, but shall be visually inspected to verify that plies of connected elements are in snug contact.

3) Where bolts or connections are defective, correct defective workmanship, remove and replace, or correct as required defective bolts and connections. CONTRACTOR shall pay for correcting defective Work and tests required to confirm integrity of corrected Work.

c. Welds: Each weld shall be visually inspected.

1) Where visually defective welds are evident, further test welds using non-destructive methods. If welds are determined to be acceptable, OWNER will pay for non-destructive testing. When welds are defective, CONTRACTOR shall pay for non-destructive testing.

2) Correct, or remove and replace, defective Work as directed by ENGINEER.

3) CONTRACTOR shall pay for corrections and subsequent tests required to determine weld compliance with the Contract Documents.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 05 14 00

STRUCTURAL ALUMINUM FRAMING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install structural aluminum framing.

2. The Work also includes:

a. Providing openings in and attachments to structural aluminum framing to accommodate the Work under this and other Sections, and providing for structural aluminum framing items such as anchorage devices, studs, and all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before structural aluminum framing Work.

C. Related Sections:

1. Section 03 60 00, Grouting.

2. Section 05 05 33, Anchor Systems.

3. Section 09 91 00, Painting.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. AA ADM-1, Aluminum Design Manual – Specifications for Aluminum Structures.

2. AISC Specifications for Structural Joints using ASTM A325 or ASTM A490 Bolts, approved by RCSC.

3. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 KSI Minimum Tensile Strength.

4. ASTM A563, Specification for Carbon and Alloy Steel Nuts.

5. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

6. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.

7. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

8. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

9. ASTM B429/B429M, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

10. ASTM F436, Standard Specification for Hardened Steel Washers.

11. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

12. ASTM F594, Specification for Stainless Steel Nuts.

13. AWS D1.2/D1.2M, Structural Welding Code - Aluminum.

14. NAAMM AMP 500, Metal Finishes Manual for Architectural and Metal Products.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Welders and Welding Processes:

a. Qualify welding processes and welding operators in accordance with AWS D1.2/D1.2M.

b. When requested by ENGINEER, provide certification that all welders employed on or to be employed on the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures, and diagrams showing proposed sequence of erection. Shop Drawings shall not be reproductions of Contract Drawings.

b. Include complete information for fabrication of the structure's components, including location, type, and size of bolts, details of blocks, copes and cuts, connections, camber, holes, member sizes and lengths, and other pertinent data. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld.

c. Provide setting drawings, templates, and directions for installing anchorage devices.

2. Product Data:

a. Copies of manufacturer's specifications and installation instructions for products listed below.

1) Welding electrodes and rods.

B. Informational Submittals: Submit the following:

1. Certificates.

a. Welders' certifications, when requested by ENGINEER.

2. Test Reports.

a. Laboratory test reports and other data required to show compliance with the Contract Documents for the following:

1) Mill test report documenting chemical and physical properties of each type of aluminum framing material.

2) Mill test report documenting chemical and physical properties of stainless steel connection bolts, nuts, and washers.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the Site at such intervals to ensure uninterrupted progress of the Work.

B. Storage:

1. Do not store materials in a manner that could cause distortion or damage to the members. Repair or replace damaged materials as directed by ENGINEER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum Types:

1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B221, Alloy 6061-T6.

2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.

3. Aluminum Bars and Rods: ASTM B211, Alloy 6061-T6.

4. Aluminum Plates: ASTM B209, Alloy 6061-T6.

B. Anchorages, Fasteners, and Connectors:

1. Anchorage Devices: Refer to Section 05 05 33 Anchor Systems.

2. Threaded Fasteners: Stainless steel bolts, ASTM F593, AISI Type 303, and stainless steel nuts and washers, ASTM F594, AISI Type 303.

C. Electrodes for Welding: ER 5356 complying with AWS D1.2/D1.2M.

D. Finish: Provide mill finish as specified in NAAMM AMP 500.

2.02 FABRICATION

A. Shop Fabrication and Assembly:

1. General:

a. Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural aluminum in accordance with AA ADM-1, the Contract Documents, and as shown on approved Shop Drawings. Provide camber in structural members as shown.

b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials for storage and minimize handling at the Site.

c. Where finishing is required, complete the assembly, including welding of units, before commencing finishing operations. Provide finish surfaces of members exposed-to-view in the completed Work that are free of markings, burrs, and other defects.

d. Design of Members and Connections:

1) Details shown on the Drawings are typical; similar details apply to similar conditions, unless otherwise shown or specified.

B. Connections:

1. Shop Connections:

a. Unless otherwise shown or indicated, shop connections may be welded or stainless steel bolted. Unless shown otherwise, welds shall be 1/4-inch minimum.

b. Where reaction values of a beam are not shown or indicated, connections shall be detailed to support the total uniform load capacity tabulated in AA ADM-1 tables for allowable loads on beams for the given shape, span, and aluminum specified for beam in question.

c. Shop-welded connections shall be detailed to eliminate or minimize eccentricity in the connection.

d. End connection angles fastened to webs of beams and thickness of angles, size and extent of fasteners or shop welds, shall comply with design standards in AA ADM-1. Connections shall be two-sided unless otherwise shown or indicated.

2. Fabrication Considerations Regarding Field Connections:

a. Unless otherwise specified below or indicated, make field connections using stainless steel bolts.

b. Field welding is not allowed.

3. Bolted Construction:

a. Stainless steel design shear values shall be based on bolts with bearing type connections with threads in the shear plane.

b. Minimum bolt diameter shall be 3/4-inch, unless otherwise shown or indicated.

4. Welded Construction: Comply with AWS D1.2/D1.2M for procedures, appearance, and quality of welds, and methods used in correcting defective welding Work.

C. Bracing:

1. Bracing for which stress is not shown or indicated shall have minimum two-bolt connection, or shop-welded connection of equivalent strength.

2. Vertical bracing and knee braces connecting to columns shall be on the centerline of columns, unless otherwise shown or indicated.

3. Knee braces shall be at 45-degree angle, unless otherwise shown or indicated.

4. Connection plates shall be minimum 3/8-inch thick, unless otherwise shown.

D. Columns: Fabrication tolerances shall be as required by AA ADM-1 and AWS D1.2/D1.2M for welded members.

E. Holes and Appurtenances for Other Work:

1. Provide holes required for securing other work to structural aluminum framing, and for passage of other work through framing members, as shown on the Shop Drawings and the Contract Documents. If large block-outs are required and approved, reinforce the webs to develop specified shear strength. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work.

2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not frame cut holes or enlarge holes by burning. Drill holes in bearing plates.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which structural aluminum Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.02 ERECTION

A. Comply with AA ADM-1 and the Contract Documents.

B. Anchorage Devices:

1. Provide anchorage devices, including anchor bolts, and other connectors required for securing structural aluminum to foundations and other in-place Work.

2. Provide templates and other devices necessary for pre-setting anchorage devices to accurate locations.

3. Refer to Section 05 05 33, Anchor Systems, for anchorage requirements.

C. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on stainless steel wedges or other adjusting devices.

2. Tighten anchorage devices after positioning and plumbing supported members. Do not remove wedges or shims, but if protruding, cut off flush with edge of the base or bearing plate prior to packing with grout.

3. Place non-shrink grout between bearing surfaces and bases or plates in accordance with Section 03 60 00, Grouting. Finish exposed surfaces, protect installed materials, and cure in compliance with grout manufacturer's instructions.

4. Leveling plates and wood wedges are not allowed.

D. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure within tolerances specified in AA ADM-1. For members requiring accurate alignment, provide clip angles, lintels and other members shall be with slotted holes for horizontal adjustment at least 3/8-inch in each direction, or more when required.

2. Splice members only where shown or indicated.

E. Erection Bolts: On exposed, welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

F. Gas Cutting: Do not use gas-cutting torches at the Site for correcting structural framing fabrication errors. Field-cutting will be allowed only on secondary members that are not under stress, as approved by ENGINEER. Finish gas-cut sections equal to sheared appearance when allowed.

G. Protection of Aluminum from Dissimilar Materials:

1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.

3.03 FIELD QUALITY CONTROL

A. OWNER will engage an independent testing and inspection agency to inspect stainless steel bolted connections and welded connections as follows:

1. Visually inspect all welds. Test wells that appear to be visually deficient using non-destructive methods by qualified testing laboratory. CONTRACTOR shall correct improper workmanship by removing and replacing, or repairing, as instructed by ENGINEER, welds that are defective. Pay for all corrections and subsequent retesting to confirm integrity of welds.

2. Visually inspect all bolted connections.

a. Visually inspect connections to verify that plies of connected elements are in snug contact.

b. Where bolts or connections are defective, correct improper workmanship and materials by removing defective bolts and connections and replacing or repairing as directed by ENGINEER. Pay for corrections and subsequent tests required to confirm integrity of connection.

3. Independent testing and inspection agency shall prepare a report on each structure. Report shall summarize observations made by inspector and be submitted to ENGINEER.

B. Correct defective structural aluminum Work. Perform additional tests, at CONTRACTOR'S expense, necessary to confirm non-compliance of the original Work and to demonstrate compliance of corrected Work.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 05 21 00

STEEL JOIST FRAMING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install steel joist framing.

2. Extent of steel joist framing is shown or indicated on the Drawings, including basic layout.

3. Types of joists required are:

a. K-series open-web steel joists.

4. The Work also includes:

a. Providing attachments to steel joist framing to accommodate the Work under this and other Sections and providing for steel joist framing all items required for which provision is not included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before steel joist framing Work.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.

2. Section 05 12 00, Structural Steel Framing.

3. Section 09 91 00, Painting.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. AISC Research Council on Structural Connections (RCSC) Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

2. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

3. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.

4. ASTM A490, Specification for Structural Bolts, Alloy Steel, Heat-Treated 150 ksi Minimum Tensile Strength.

5. AWS D1.1/D1.1M, Structural Welding Code – Steel.

6. SJI Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Fabricator: Materials and products shall be fabricated by firm regularly engaged in manufacturing the types of steel joist required. Manufacturer shall have at least two years of experience fabricating joists similar to those required.

2. Welders and Welding Work:

a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, Section 5 Qualifications.

b. Provide certification that welders to be employed on the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Detailed drawings showing layout of joist units, headers, special connections, jointing and accessories. Include the mark, number, type, location, and spacing of joists and bridging.

b. Provide location drawings for installing anchorage devices.

2. Product Data:

a. Copies of manufacturer's specifications and product data for each type of joist and its accessories.

B. Informational Submittals: Submit the following:

1. Certifications:

a. Manufacturer's certification that joists comply with SJI Specifications.

b. Copies of AWS certification for each welder.

2. Manufacturer's Instructions:

a. Copies of manufacturer's installation instructions for each type of joist and its accessories.

3. Site Quality Control Submittals:

a. Submit results of testing and inspection performed at the Site by testing agency employed by CONTRACTOR.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle steel joists as recommended in SJI Specifications and the Contract Documents. Handle and store joists to avoid deforming members and avoid imposing excessive stresses.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel: Comply with SJI Specifications and applicable requirements of Section 05 12 00, Structural Steel Framing.

2.02 MANUFACTURERS

A. Products and Manufacturers: Provide one of the following:

1. Open Web Steel Joists, K-Series, by Vulcraft, Division of Nucor Corporation.

2. Open Web Steel Joists, K-Series, by New Columbia Joist Company.

3. Or equal.

2.03 FABRICATION

A. General: Fabricate steel joists in accordance with SJI Specifications and the Contract Documents.

B. Bottom Chord: Joists with bottom chords consisting of round bars are not allowed.

C. Holes in Chord Members:

1. Provide holes in chord members where shown or indicated for securing other work to steel joists.

D. Extended Ends:

1. Provide extended ends on steel joists where shown or indicated, complying with manufacturer's standards and requirements of applicable SJI Specifications and load tables.

E. Ceiling Extension:

1. Provide ceiling extensions in areas having ceilings attached directly to steel joist bottom chord. Provide either an extended bottom chord element or separate unit, to suit manufacturer's standards, of sufficient strength to support ceiling construction. Extend ends to within 1/2-inch of finished wall surface, unless otherwise shown or indicated.

F. Bridging:

1. Provide horizontal or diagonal-type bridging for open web joists, complying with SJI Specifications.

G. End Anchorage: Provide end anchorages to secure joists to adjacent construction, complying with SJI Specifications, unless otherwise shown or indicated in the Contract Documents.

H. Header Units: Provide header units to support interrupted open web joists at openings in floor or roof system not framed with steel shapes.

2.04 FINISHING

A. Surface Preparation and Shop Priming: Perform surface preparation ad apply primer coat to steel joists in the shop, in accordance with specified in Section 09 91 00, Painting.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine substrate and conditions under which the Work is to be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 ERECTION

A. Install and secure steel joists in accordance with SJI Specifications, approved Shop Drawings, and the Contract Documents.

B. Placing Joists:

1. Do not install steel joists until supporting Work is in place and secured. Place joists on supporting Work, adjust, and align in accurate locations and spacing before permanently fastening.

2. Provide temporary bridging, connections, and anchors to ensure lateral stability during construction.

C. Bridging:

1. Install bridging simultaneously with joist erection.

D. Fastening Joists:

1. Field-weld joists to supporting steel framework in accordance with SJI Specifications for type of joists used. Coordinate welding sequence and procedure with placing of joists.

2. Bolt joists to supporting steel framework in accordance with SJI Specifications for type of joists used.

    a. Provide unfinished, threaded fasteners for bolted connections, unless otherwise shown or indicated in the Contract Documents.

    b. Provide unfinished, threaded fasteners for bolted connections, except where high-strength bolts or welded connections are shown or indicated in the Contract Documents.

    c. Provide high-strength, threaded fasteners for bolted connections of steel joists to steel columns, and at other locations where shown or indicated in the Contract Documents, installed in accordance with AISC RCSC Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

E. Touch-up Painting:

1. Unless otherwise shown or indicated in the Contract Documents, comply with requirements for touch-up painting in Section 09 91 00, Painting.

2. After joist installation, paint the following: all field-bolted heads and nuts, welded areas, and abraded or rusty surfaces on joists and steel supporting members. Wire-brush surfaces and clean with solvent before painting. Paint exposed areas with the same paint used for shop painting. Apply by brush or spray to provide minimum dry film thickness specified in Section 09 91 00, Painting.

3.03 FIELD QUALITY CONTROL

A. OWNER will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

1. All high-strength bolted connections shall be visually inspected. Inspection shall be made to verify compliance with Sections 2, 3 and 8 of AISC RCSC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. For connections that are slip critical or subject to axial tension, inspector shall verify that proper pretensioning was provided. For connections that are not slip critical nor subject to direct tension, bolt does not need to be inspected for bolt tension, and shall be visually inspected to verify that plies of connected elements have been brought into snug contact. Where bolts and connections Work are defective, CONTRACTOR shall correct improper workmanship, remove and replace, or correct as instructed, all defective bolts and connections. CONTRACTOR shall pay for all corrections and subsequent tests required to confirm integrity of connections.

2. Testing agency shall conduct and interpret tests and shall state in each report whether test specimens comply with requirements, and shall specifically state all deviations.

3. Provide access for special inspectors and testing agency to places where steel joist Work is fabricated or produced.

4. Testing agency may inspect structural steel joists at fabricator's shop before shipment; however, ENGINEER reserves the right, at any time before completion and readiness for final payment, to reject defective Work.

5. Welds shall be visually inspected. Where defective welds are observed, welds shall be tested using non-destructive methods by certified testing laboratory. If welds are found to be satisfactory, OWNER will pay for testing. Where welds are defective, CONTRACTOR shall pay for testing. CONTRACTOR shall correct defective Work, remove and replace, or correct as instructed, all welds found to be defective. CONTRACTOR shall pay for all corrections and subsequent tests required to confirm weld integrity.

6. Correct defective structural steel joist Work which inspection and laboratory test reports indicate do not comply with the Contract Documents. Perform additional tests, as necessary, to confirm non-compliance of the original Work, and as necessary to demonstrate compliance of corrected Work.

END OF SECTION

SECTION 05 31 23

STEEL ROOF DECKING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install galvanized steel roof decking.

2. Steel roof decking Work shall include all incidentals required to complete the Work. The Work also includes:

a. Cutting and flashing of openings to accommodate the Work under this and other Specification Sections, and providing for the steel roof decking all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Specification Sections and coordinate the installation of items to be installed with or before steel roof decking Work.

C. Related Sections:

1. Section 05 12 00, Structural Steel Framing

2. Section 09 91 00, Painting.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. AISI S100, North American Specification for the Design of Cold-Formed Steel Structural Members, with Supplements.

2. ANSI/SDI RD1.0, Steel Roof Deck.

3. ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

4. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel

5. ASTM C1513 Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections

6. ASTM F1941, Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))

7. AWS D1.3/D1.3M, Structural Welding Code – Sheet Steel.

8. ICC-ES AC43, Acceptance Criteria for Steel Deck Roof and Floor Systems.

9. ICC-ES AC70, Acceptance Criteria for Fasteners Power Driven Into Concrete, Steel, and Masonry Elements.

10. ICC-ES AC118, Acceptance Criteria for Tapping Screw Fasteners.

11. MIL-P-21035B, Paint, High Zinc Dust Content Galvanizing Repair.

12. SAE J78, Steel Self-Drilling Tapping Screws.

13. SDI MOC2, Manual of Construction with Steel Deck.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

a. Manufacturer shall have not less than five years experience producing products substantially similar to those required and, upon ENGINEER's request, shall submit evidence of not less than five installations in satisfactory operation for not less than five years each.

2. Erector:

a. Engage an experienced erector to perform the Work of this Section who has specialized in erecting and installing steel roof decking similar to that required for the Project and who is acceptable to the steel roof decking manufacturer.

b. Submit name and qualifications to ENGINEER, with the following information for not less than three successful, completed projects:

1) Names and telephone numbers of owners, and architects or engineers responsible for each project.

2) Approximate contract cost of the steel roof decking work.

3) Area of roof decking installed.

3. Welders and Welding Processes:

a. Qualify welding processes and welding operators in accordance with AWS D1.3/D1.3M.

b. Submit certification that each welder employed on or to be employed for the Work possesses current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.

B. Component Supply and Compatibility:

1. Obtain all products required in this Section, regardless of component manufacturer, from a single steel roof decking manufacturer.

2. Steel roof decking manufacturer shall prepare, or review and approve, all Shop Drawings and other submittals for components furnished under this Section.

3. Components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by steel roof decking manufacturer.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Erection drawings showing the extent of coverage of each section of metal deck. Show deck cross section, size and spacing of welds to supports, side laps, and end laps. Show adaptations around openings and other special conditions that detail the method of fastening sections to supporting construction, the procedure for attaching end closure plates and butt joint cover plates, miscellaneous flashing, and accessories.

b. Listing of all mechanical fastener products proposed for use in the Work including product type, and intended location in the Work.

2. Product Data:

a. Manufacturer's catalogs, literature, specifications, load tables, and dimension diagrams for the following:

1) Steel Deck and accessories; including load tables that indicate uniform load capacities and diaphragm shear strengths for the appropriate deck, span conditions, and fastening system. Include the section properties for the specified deck.

2) Mechanical Fasteners: Including acceptable base material conditions and thickness ranges for each type of fastener, copies of valid ICC-ES reports that provide evaluation criteria, load carrying capacities and installation requirements.

B. Informational Submittals: Submit the following:

1. Field Quality Control Submittals:

a. Reports by testing laboratory in accordance with Paragraph 0 of this Section.

2. Qualifications Statements: As specified in Paragraph 1.03A of this Section for the following:

a. Manufacturer, when requested by ENGINEER.

b. Erector.

c. Testing laboratory.

d. Welders and welding processes.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. System Description:

1. Provide steel roof decking systems at the locations shown on the Drawings.

2. Deck configuration is indicated in Paragraph 2.03A of this Section.

B. Design and Performance Criteria:

1. Unless otherwise shown or indicated, material, design, fabrication and erection shall be in accordance with AISI S100 and ANSI/SDI RD1.0.

2. Determine the properties of steel roof deck sections on the basis of the effective design width as limited by AISI S100. Provide not less than the deck section properties shown, including section modulus and moment of inertia per foot of width.

3. Allowable Deflection: The lesser of the following: 1/240 of span (centerline to centerline), or one inch, under the uniformly-distributed design live load. Spans are to be considered center-to-center of supports.

4. Allowable Diaphragm Shear Strength: Provide deck, fasteners and fastener layout that provide a shear strength that meets or exceeds the design shear strength shown or indicated.

2.02 MATERIALS

A. Galvanized Steel Sheet:

1. Material: ASTM A653/A653M, structural steel, with yield strength of not less than 33 ksi.

2. Zinc Coating shall be G60 on each side.

3. Minimum nominal thickness before coating shall be 20-gage, unless otherwise indicated.

B. Deck shall have sheet lengths that are continuous over three or more spans, wherever practicable.

C. Accessories shall be formed of the same material used for the steel deck.

D. Miscellaneous Steel Shapes: Refer to Section 05 12 00, Structural Steel Framing.

E. Galvanizing Repair Paint: High zinc-dust content paint for repairing damaged galvanized surfaces. Paint shall be in accordance with MIL-P-21035B.

F. Flexible Closure Strips for Deck: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

G. Mechanical Fasteners: Anchorage of the steel deck using mechanical fasteners, either powder actuated, pneumatically driven, or screws, will be allowed in lieu of welding, when the fasteners comply with the following:

1. Design Requirements: Comply with ANSI/SDI RD1.0. Type and spacing of fastener shall be equal to or greater than the puddle weld method shown or specified. Documentation in the form of ICC-ES reports, test data, diaphragm design tables or design charts shall be submitted by the fastener manufacturer as a basis for obtaining approval for this method of attachment.

2. Powder-Actuated and Pneumatic Fasteners:

a. Fasteners shall have a current evaluation report by ICC-ES for use in fastening metal deck to steel substrate, as tested and assessed in accordance with ICC-ES AC43, and ICC-ES AC70.

b. Products and Manufacturers: Provide one of the following.

1) X-ENP-19 L15, X-END19 THQ 12, X-ENDK22 THQ 12 Powder Actuated Fasteners, by Hilti, Inc.

2) K65056, K65062, SD65075, K64062, SDK63075 Air/Safe Fastening System, by Pneutek.

3) Or equal.

c. Substrate: Do not use powder-actuated or pneumatically-driven fasteners if supporting structural steel substrate is less than 1/8-inch thick.

d. Material: Hardened carbon steel.

e. Hardness: Minimum 52 Rockwell.

f. Shape and Manufacturing Process: Knurled shank, forged point. Manufacturing process shall include steps to ensure fastener ductility and quality.

g. Shank Diameter: 0.145-inch minimum.

h. Head/Washer Diameter: Nominal 1/2-inch minimum.

i. Finish: Zinc-coated complying with ASTM B633, Sc. 1, Type III.

3. Self-Drilling Self Tapping Screws:

    a. Fasteners shall have a current evaluation report by ICC-ES for use in fastening metal deck side laps, as tested and assessed in accordance with ICC-ES AC43 and ICC-ES AC118.

    b. Products and Manufacturers: Provide one of the following.

        1) S-SLC 01 M HWH, S-SLC 02 M HWH Side Lap Connectors, by Hilti, Inc.

        2) Grabber Self Drilling Screws, by John Wagner Associates, Inc.

        3) Or equal.

    c. Manufacture screws from heat-treated steel wire. Comply with SAE J78 and ASTM C1513.

    d. Substrate: Do not use screw fasteners if the supporting structural steel substrate is greater than 1/8 inch thick.

    e. Material: Carbon steel.

    f. Size: Provide number 10 screws for deck gages 22 thru 26, number 12 screws for thicknesses greater than 22 gage.

    g. Finish: Zinc-coated in accordance with ASTM F1941.

2.03 FABRICATION

A. General:

1. Form deck units in lengths to span three or more supports with flush, telescoped or nested two-inch end laps and nesting side laps, unless otherwise shown. Provide deck configurations complying with SDI MOC2, and as specified in this Section.

B. Wide-Rib Deck:

1. Depth: Approximately 1.5 inches; ribs spaced approximately six inches on centers; width of rib opening at roof surface not more than 2.5 inches; width of bottom rib surface not less than 1.75 inches.

2. Products and Manufacturers: Provide one of the following:

    a. Type B Roof Deck, by Vulcraft, a Division of Nucor Corporation.

    b. Type B Roof Deck, by Metal Deck Group, a Division of Consolidated Systems, Inc.

    c. Type B Roof Deck, by DACS, Inc.

    d. Or equal.

C. Roof Sump Pans:

1. Fabricate each from one piece galvanized sheet steel, not less than 14-gage thickness, of the same quality as deck units, with level bottoms and sloping sides to direct water flow to drain, unless otherwise shown.

2. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than three inches wide.

3. Recess pans not less than 1.5 inches below roof deck surface, unless otherwise shown or required by deck configuration.

4. Holes for drains shall be cut in the field.

D. Cant Strips:

1. Fabricate cant strips of galvanized sheet steel, not less than 20-gage thickness, of the same quality as the deck units.

2. Bend cant strips to form a 45-degree cant not less than five inches wide, with top and bottom flanges not less than two inches wide, unless otherwise shown.

3. Provide cant strips in ten-foot lengths, where possible.

E. Ridge and Valley Plates:

1. Fabricate ridge and valley plates of galvanized sheet steel, not less than 20-gage thickness, of the same quality as the deck units; each leg not less than 2.25 inches wide, bent to provide tight-fitting closure with deck units.

2. Provide plates in ten-foot lengths, where possible.

F. Steel Filler and Closure Strips:

1. Fabricate steel closure strips of galvanized sheet steel, not less than 20-gage thickness, of same quality as the deck units.

2. Form to the configuration required to provide tight-fitting closures at open ends and sides of decking.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. General:

1. Install roof deck units and accessories in accordance with manufacturer's recommendations, and approved Shop Drawings and other approved submittals, and in accordance with the Contract Documents.

2. Install deck in a continuous operation to avoid delaying the construction.

B. Placing Roof Deck Units:

1. Place roof deck units on supporting steel framework and adjust to final position with ends bearing on supporting members and accurately aligned end to end before permanently fastening. Lap ends not less than two inches. Do not stretch or contract the side-lap interlocks. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.

2. Form deck sheet at longitudinal sides in such manner that sides will overlap and interlock, and preclude the possibility of the dripping of cement paste from the concrete placed on it. End laps shall occur over bearings only.

3. Coordinate and cooperate with structural steel erector in locating deck bundles to prevent overloading of structural members

4. Do not use deck units for storage or working platforms until permanently secured.

5. Steel deck shall provide a continuous uniform slope, with practically flush top surfaces, and shall be installed in straight and continuous rows, as far as practicable, with ribs at right angles to the supporting members.

6. Erect and properly align deck prior to fastening deck to supporting steel.

C. Fastening Deck Units: Fasten steel deck units to steel framework by the arc-welding process or with approved mechanical fasteners.

1. Welding:

a. Welds shall be free of sharp points and edges. Clean welds immediately, by chipping or wire brushing, and coat welds with zinc dust type primer paint.

b. Welding shall be performed by qualified welders in accordance with AWS D1.3.

c. Weld deck units to the steel supporting members using the welding pattern shown.

d. Before insulation is installed, replace welds found to be defective.

2. Mechanical Fastening:

a. Comply with manufacturer's requirements for installation procedures for mechanical fastener attachment methods.

b. Fasten deck units to the steel supporting members using the fastener pattern shown.

c. Before insulation is installed, replace all fasteners found to be defective.

D. Cutting and Fitting:

1. Cut and fit roof deck units and accessories around other work projecting through or adjacent to the roof deck. Provide neat, square and trim cuts.

E. Reinforcing at Openings:

1. Provide additional steel reinforcing and closure pieces as required for strength, continuity of deck, and to support other work, unless otherwise shown.

2. Reinforce roof deck around openings less than 15 inches in any dimension by means of a flat steel sheet placed over the opening and fastened to the top surface of deck. Provide steel sheet of the same quality as deck units, not less than 20-gage thickness, and not less than 12 inches wider and 12 inches longer than the opening. Provide welds or mechanical fasteners at each corner and spaced not more than 12 inches on centers along each side.

F. Roof Sump Pans:

1. Place roof sump pans over openings provided in the roof deck and fasten to the top deck surface. Space fasteners or welds not more than 12 inches on centers with at least one attachment at each corner. Cut opening in the bottom of roof sump to accommodate drain size shown.

G. Cant Strips:

1. Fasten cant strips to the top surface of roof deck, and secure to wood nailers with galvanized steel screws, and to steel framing with welds or galvanized steel self-tapping screws. Space fasteners or welds at 12 inches on centers and lap end joints not less than three inches and secure with galvanized steel sheet metal screws.

H. Ridge and Valley Plates:

1. Fasten ridge and valley plates to the top surface of roof deck with welds or self-drilling screws. Lap end joints not less than three inches, with laps made in the direction of water flow.

I. Closure Strips:

1. Provide steel closure strips at open uncovered ends and edges of roof deck, and in the voids between deck and other construction. Fasten into position to provide a complete deck installation.

J. Roof Insulation Support:

1. Provide steel closure strips for supporting roof insulation where rib openings in the top surface of roof deck occur adjacent to edges and openings. Fasten closure strips into position.

K. Touch-up Painting:

1. After completion of roof deck installation, wire-brush clean and paint scarred and damaged areas, welds, and rust spots on supporting steel members in accordance with Section 09 91 00, Painting.

2. Touch-up galvanized top and bottom surfaces of deck units with galvanizing repair paint applied in accordance with the paint manufacturer's instructions and recommendations.

FIELD QUALITY CONTROL

L. OWNER will employ testing laboratory to inspect welded connections and to perform tests and prepare test reports.

1. All welds will be subject to visual inspection. Where visually deficient welds are observed, welds will be tested using non-destructive methods by certified testing laboratory. If welds are found to be satisfactory, OWNER will pay for testing. Where welds are found unacceptable or deficient, CONTRACTOR will pay for testing. CONTRACTOR shall correct improper workmanship, remove and replace, or correct as instructed, welds found unacceptable or deficient. CONTRACTOR shall pay for corrections and subsequent tests required to confirm the integrity of the weld.

2. Correct deficiencies in steel roof deck Work that inspection and laboratory test reports indicate do not comply with the Contract Documents. Perform additional tests as required to confirm non-compliance of the original Work, and as may be necessary to demonstrate compliance of corrected Work.

3. Work not in compliance with the Contract Documents and, where the Contract Documents do not include detailed requirements, Work that is not in accordance with generally-accepted standards of the trade, will be deemed defective. All Work that is defective shall be corrected or replaced as directed by ENGINEER. Corrections, re-design, and replacement of defective Work shall be at CONTRACTOR's expense

END OF SECTION

SECTION 05 50 00
MISCELLANEOUS METALS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Provide miscellaneous metals, shop fabricated and manufactured in accordance with the schedule.

B. Primer.

1.03 RELATED WORK

1. Section 09 90 00 – Painting

1.04 REFERENCES

A. ASTM A36 – Structural Steel.

B. ASTM B26 – Cast Aluminum.

C. ASTM A53 – Steel Pipe, Hot Dipped, Zinc Coated Welded and Seamless.

D. ASTM 500 – Steel Tubing, Cold-formed, Welded and Seamless.

E. FS TT-P_86 – Paint, Ready-Mixed.

F. AWS D1.1 – Structural welding Code.

1.05 SUBMITTALS

A. Submit shop drawings under provisions of Section 01 33 00 indicating in detail, sizes, material and gage, methods of securing and anchoring and finish.

1. Include erection drawings, elevations and details where applicable.
2. Indicate welded connections using standard AWS welding symbols.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Miscellaneous Structural Steel: ASTM A36.

B. Cast Aluminum: ASTM B26.

C. Steel Pipe: ASTM 53, Standard Weight.

D. Steel Tubing: ASTM A500, Grade B.

E. Fasteners: Bolts, nuts, washers, screws, expansion shields, suitable for intended use.

F. Finish: Primer for Ferrous Metal: Fast-curing, lead-free, abrasion-resistant, rust-inhibitive primer selected for compatibility with substrates and with types of alkyd-type finish paint systems indicated, and for capability to provide a sound foundation from field-applied topcoats despite prolonged exposure; complying with performance requirements only of FS TT-P-86, Types I, II, and III. Paint exposed to view surfaces unless noted otherwise

2.02 SCHEDULE OF ITEMS

A. Anchors: Unless specifically exempted, provide all sleeves, inserts and bolts required in conjunction with items of work included under this section and under other trades where necessary for securing work in place. Sizes, kinds and spacing of bolts and/or anchors not indicated or specified shall be as directed. Installation of anchors for other trades shall be the responsibility of the respective trades.

B. Miscellaneous Plates and Shapes: Provide items that do not form a part of the structural steel frame work, such as lintels, angles and plates, steel stringers and treads, miscellaneous mountings, and framing as needed to complete the work whether specifically indicated or identified in the Documents. Where indicated and no size is provided, contractor shall bid accordingly and request clarification prior to construction. No additional cost will be considered. Fabricate items from ASTM A36 steel.

C. Supports for Millwork: Steel brackets and supports for items such as millwork shall be provided for necessary support. Provide angle frames and legs fabricated from 1" x 1" 11 gage steel tubing with 1/8”-thick steel plate anchors welded-on at 45° angles and punched for 1/4” anchors for countertops, unless otherwise indicated. All welds shall be ground smooth.

D. All exposed to view miscellaneous support members shall be primed and painted and all exposed to view, coping, downspouts, flashing, and similar type metals shall be pre-finished.

E. Strapping and banding: Provide all necessary strapping, banding, and bars as required to support items attached to walls such as flashing and counterflashing, Total Flash system, wall supported items, and miscellaneous support and bracing for both interior and exterior metal stud walls

PART 3 – EXECUTION

3.01 GENERAL: Verify all measurements and take necessary field measurements before fabrication. Weld in accordance with AWS Code D1.1. Furnish exposed fasteners on compatible materials, matching color and finish, and harmonizing with the service where applied. Include materials and

parts necessary to complete each item. Provide necessary miscellaneous bolts and anchors, supports, braces, and connections. Fabricate or match the necessary rebates, lugs, and brackets to permit neat and substantial assembly. Punch or drill holes for bolts and screws. Use concealed fasteners where practicable. Form weather-exposed joints to exclude water.

3.02 WORKMANSHIP: Form miscellaneous metalwork to shape and size required with sharp lines and angles and true curves. Drill and punch in proper alignment and to match well at mated parts. Weld continuously, except where tack welding is permitted. Make exposed welds continuous and grind smooth. Smoothly finish exposed surfaces of work in place. Cope or miter corner joints. Set work accurately to established lines and elevations and fasten securely.

3.03 SHOP PAINTED

All ferrous metals, except those portions embedded in concrete, shall receive a shop coat of primer.

END OF SECTION

SECTION 05 50 00

MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish miscellaneous metal fabrications, including surface preparation and shop priming.

B. The extent of miscellaneous metal fabrications Work is shown on the Drawings and includes items fabricated from iron, steel and aluminum shapes, plates, bars, castings and extrusions, which are not a part of the structural steel or other metal systems covered by other Sections of these Specifications.

C. The types of miscellaneous metal items include, but are not limited to the following:

1. Aluminum ladders.

2. Extruded aluminum stair nosings.

3. Bollards

4. Miscellaneous framing and supports.

5. Miscellaneous accessories and fasteners.

6. Seat Angles, supports and brackets.

D. Related Sections:

1. Section 05 05 33, Anchor Systems.

2. Section 05 52 15, Aluminum Handrails and Railings.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified:

1. ASTM A 36, Specification for Carbon Structural Steel.

2. ASTM A 153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

3. ASTM A 240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

4. ASTM A 276, Stainless and Heat-Resisting Steel Bars and Shapes.

5. ASTM A 320, Specification for Alloy Steel Bolting Material for Low Temperature Service.

6. ASTM B 209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

7. ASTM B 211, Specification for Aluminum and Aluminum-Alloy Bars, Rods and Wire.

8. ASTM B 221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

9. ANSI A14.3, Safety Requirements for Fixed Ladders.

10. AWS D1.1, Structural Welding Code.

11. NAAMM, Metal Finishes Manual.

12. OSHA.

B. Field Measurements:

1. Take field measurements where required prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.

C. Shop Assembly:

1. Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Fabrication and erection details of all assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for location and installation of miscellaneous metal items and anchorage devices.

2. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Plates, Shapes and Bars: ASTM A 36.

B. Aluminum:

1. Alloy and Temper: Provide alloy and temper as shown on the Drawings or specified, or as otherwise recommended by the aluminum producer or finisher.

2. Extruded Shapes and Tubes: ASTM B 241.

3. Plate and Sheet: ASTM B 209.

4. Bars, Rods and Wire: ASTM B 211.

C. Stainless Steel Plates, Sheets and Bars: ASTM A 276, Type 316 stainless steel.

1. Use Type 316 stainless steel unless shown otherwise in the Drawings.

D. Stainless Steel Fasteners and Fittings: ASTM A 320.

E. Surface Preparation and Shop Priming: All steel shall be primed in the shop.

F. Galvanizing: All galvanizing of fabricated steel items shall comply with the requirements of ASTM A 123.

G. Aluminum Finish: Provide an Architectural Class I anodized finish for all aluminum work unless specifically shown or specified to be mill or other finish.

2.02 MISCELLANEOUS METAL ITEMS

A. Aluminum Ladders:

1. Fabricate ladders for the locations shown on the Drawings, with dimensions, spacings, details and anchorages as shown on the Drawings, and specified. Comply with the requirements of ANSI A14.3, except as otherwise shown on the Drawings or specified.

a. Unless otherwise shown on the Drawings, provide 1 1/2-inch diameter Schedule 40 side rails, spaced 18-inches apart, minimum.

b. Provide extruded square rungs, spaced 12-inches on centers, maximum with non-slip surface on the top of each rung. Adhesive strips for non-slip surfaces will not be allowed.

2. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

3. Support each ladder at top and bottom and at intermediate points spaced not more than five feet on centers. Use welded or bolted brackets, designed for adequate support and anchorage, and to hold the ladder clear of the wall surface with a minimum of 7-inches clearance from wall to centerline of rungs. Unless otherwise shown on the Drawings, or approved by the ENGINEER, extend rails 42-inches above top rung, and return rails to wall or structure, unless other secure handholes are provided. If the adjacent structure does not extend above the top rung, goose neck the extended rails back to the structure to provide secure ladder access.

4. Use extruded aluminum conforming to alloy and temper of the 5000 series alloys.

B. Fall Prevention System: All ladders greater than 12-feet-0-inches in height shall be provided with a fall prevention system. The system shall meet OSHA standards.

1. The system shall consist of a rail permanently attached to the ladder to which a harness belt is attached. The rail shall be notched and constructed of aluminum. Ladder attachments shall be provided as required by the manufacturer. A removable extension section shall be provided at the top of the ladder.

2. Product and Manufacturer: Provide one of the following:

a. Saf-T-Climb by Norton Company.

b. Vi-Go Ladder Climbing Safety System by Miller Fall Protection

C. Aluminum Stairs:

1. Stringers: 6061-T6 aluminum alloy.

2. Stair Treads:

a. Aluminum of same type specified under Aluminum Grating.

b. Of sizes indicated on the Drawings and 1-3/4 inch minimum depth with cast abrasive type safety nosings.

3. Handrails and Guardrails: Aluminum pipe specified under Aluminum Handrails and Guardrails (Nonwelded Pipe).

4. Fasteners: Type 316 stainless steel.

D. Extruded Aluminum Stair Nosings:

1. Fabricate of sizes and configurations required for the Work.

a. Unless otherwise shown on the Drawings, provide ribbed abrasive filled type, using black abrasive filler.

2. Provide anchors for embedding in concrete, either integral or applied to treads, as standard with the manufacturer.

3. Product and Manufacturer: Provide stair nosings by one of the following:

a. American Abrasive Metals Company.

b. Wooster Products Incorporated.

E. Bollards: Unless shown otherwise in the Drawings, provide 8-inch diameter, Schedule 40 galvanized steel pipe, 4-feet-0-inches above grade, 4-feet-0-inches below grade. Fill with

concrete and mound top. Bollards shall be primed in the shop. Surface preparation and painting shall conform to the requirements of Section 09 91 00.

F. Miscellaneous Framing and Supports:

1. Provide miscellaneous metal framing and supports, which are not a part of the structural steel framework and are required to complete the Work.

2. Fabricate miscellaneous units to the sizes, shapes and profiles shown on the Drawings or, if not shown on the Drawings, of the required dimensions to receive adjacent grating, plates, tanks, doors, or other work to be retained by the framing. Except as otherwise shown on the Drawings, fabricate from structural shapes, plates, and bars, of all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the Work.

3. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

a. Except as otherwise shown on the Drawings, space anchors, 24-inches on centers, and provide units the equivalent of 1-1/4 by 1/4 by 8-inch strips.

b. All material shall be Type 316 stainless steel unless noted otherwise in the Drawings.

G. Fasteners and Fittings: Provide Type 316 stainless steel, for all aluminum fabrications, and zinc coated hardware for all galvanized fabrications, unless otherwise shown on the Drawings or specified.

H. Surface Preparation and Shop Priming: All miscellaneous metal fabrications shall be primed in the shop.

I. Aluminum Finish: Provide an Architectural Class 1 anodized finish, AA M32C22 A41, clear, as specified in NAAMM Manual.

PART 3 EXECUTION

3.01 INSTALLATION

A. Set miscellaneous metal fabrications accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry or similar construction.

B. Anchor securely as shown on the Drawings or as required for the intended use, using concealed anchors wherever possible.

C. Fit exposed connections accurately together to form tight hairline joints. Weld steel connections, which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind steel joints smooth and touch up shop paint

coat. Do not weld, cut or abrade the surfaces of exterior units, which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Protection of Aluminum from Dissimilar Materials:

1. Coat all surfaces of aluminum in contact with dissimilar materials, such as concrete, grout, masonry and steel or other dissimilar metals with the following:

a. Cast Aluminum: Heavy coat of bituminous paint.

b. Extruded Aluminum: Two coats of clear lacquer.

2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

E. E. All welds to be coated shall be grinded smooth according to NACE “Surface Preparation of Welds Prior to Coating”.

END OF SECTION

SECTION 05 52 15

ALUMINUM HANDRAILS AND RAILINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install aluminum handrail and railing systems. The Work also includes:

a. Providing openings in, and attachments to, aluminum handrail and railing systems to accommodate the Work under this and other Specification Sections. Provide all items for aluminum handrails and railings, including anchorages, fasteners, studs, and other items required for which provision for is not specifically included under other Sections.

2. Aluminum handrails and railings Work shall include components and features shown and specified, and all components and features available from specified manufacturers required for providing complete aluminum handrail and railing system in accordance with the Contract Documents.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum handrails and railings Work.

2. Aluminum handrail and railing locations shall comply with Laws and Regulations.

C. Related Sections:

1. Section 03 60 00, Grouting.

2. Section 05 05 33, Anchor Systems.

3. Section 09 91 00, Painting.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. AA, Aluminum Design Manual.

2. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.

3. ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

4. ASTM B136, Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.

5. ASTM B137, Standard Test Method for Measurement of Coating Mass per Unit Area on Anodically Coated Aluminum.

6. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

7. ASTM B241/B241M, Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

8. ASTM B244, Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.

9. ASTM B247, Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and rolled Ring Forgings.

10. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

11. ASTM E 935, Standard Test Methods for Permanent Metal Railing Systems and Rails for Buildings.

12. NAAMM/Architectural Metal Products Division (AMP), Pipe Railing Manual.

13. NAAMM/AMP AMP 501 Finishes for Aluminum.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

a. Upon request manufacturer shall submit document at least five years successful experience in fabricating aluminum handrail and railing systems of scope and type similar to that required.

2. Professional Engineer:

a. CONTRACTOR or handrail and railing manufacturer shall retain a registered professional engineer legally qualified to practice in same state as the Site. Professional engineer shall have at least five years experience designing aluminum handrails and railings.

b. Responsibilities include:

1) Reviewing aluminum handrail and railing system performance and design criteria stated in the Contract Documents.

2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.

3) Preparing or supervising preparation of design calculations verifying compliance of aluminum handrail and railing system with requirements of the Contract Documents.

4) Signing and sealing all calculations.

5) Certifying that:

a) Design of aluminum handrail and railing system was performed in accordance with performance and design criteria stated in the Contract Documents, and

b) Design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.

3. Installer:

a. Retain a single installer trained and with record of successful experience in installing aluminum handrail and railing systems.

b. Installer shall have record of successfully installing aluminum handrail and railing systems in accordance with recommendations and requirements of manufacturer, or shall provide evidence of being acceptable to the manufacturer.

c. Installer shall employ only tradesmen with specific skill and successful experience in the type of Work required.

d. When requested by ENGINEER, submit name and qualifications of installer with the following information for at least three successful, completed projects:

1) Names and telephone numbers of owner and architect or engineer responsible for each project.

2) Approximate contract cost of the aluminum handrail and railing systems for which installer was responsible.

3) Amount (linear feet) of aluminum handrail and railing installed.

B. Component Supply and Compatibility:

1. Obtain all materials furnished under this Section regardless of component manufacturer, from a single aluminum handrail and railing system manufacturer.

2. Aluminum handrail and railing system manufacturer shall review and approve or prepare all Shop Drawings and other submittals (except for delegated design

submittals, when professional engineer is retained by other than handrail and railing manufacturer) for all components furnished under this Section.

3. Components shall be specifically constructed for specified service conditions and shall be integrated into overall assembly by aluminum handrails and railings manufacturer.

C. Regulatory Requirements: Comply with Laws and Regulations including:

1. OSHA Part 1910.23, Guarding Floor and Wall Openings and Holes.

D. Certifications:

1. Submit certification, signed by authorized officer of manufacturer and notarized, stating that handrail and railing systems comply with the design prepared by the professional engineer.

2. Submit certification, signed by authorized officer of CONTRACTOR and notarized, stating that all components and fittings are furnished by the same manufacturer.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Drawings for fabrication and installation of aluminum handrail and railing systems with sizes of members, pipe wall thickness, information on components, and anchorage devices. Show all anchorages. Provide details drawn at scale of 1.5-inch equal to one foot.

b. Indicate required location of posts.

c. Indicate locations and details of all expansion joints, if any.

d. Indicate locations and details of gaps across seismic joints, if any.

e. Profile drawings of aluminum handrail and railing system components.

f. Custom detail drawings. Details of forming, jointing, sections, connections, internal supports, trim and accessories. Provide details drawn at scale of 1.5-inch equal to one foot.

2. Product Data:

a. Manufacturer's specifications, standard detail drawings, and installation instructions for aluminum handrail and railing systems.

b. Manufacturer's catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by ENGINEER.

3. Delegated Design Submittals:

a. Design Data:

1) Design computations or complete structural analysis of handrail and railing systems, signed and sealed by professional engineer. Professional engineer's seal shall be clearly legible, including state of registration, registration number, and name on seal.

2) Certification by professional engineer that professional engineer has performed design of aluminum handrail and railing systems in accordance with performance and design criteria stated in the Contract Documents, and that design conforms to all local, state, and federal Laws and Regulations, and to prevailing standards of practice.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Certification on source of supply, as specified in Article 1.03 of this Section.

b. Manufacturer certification specified in Article 1.03 of this Section.

2. Qualifications Statements: Submit qualifications for the following:

a. Manufacturer, when requested by ENGINEER.

b. Professional engineer.

c. Installer, when requested by ENGINEER. Qualifications statement shall include record of experience with references specified.

C. Closeout Submittals: Submit the following:

1. Maintenance Manuals: Furnish detailed maintenance manuals that include the following:

a. Product name and number.

b. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions in use of products that may be detrimental to finish when improperly applied.

c. Handrail and railings systems manufacturer's current catalog including individual parts.

d. Maintenance manuals shall be in accordance with Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Submit the following:

1. Extra Stock Materials:

a. After completing installation, deliver to OWNER 10 percent of actual quantity of each handrail and railing system component used in the Work.

b. Label each piece or sealed container with name and product number.

1.05 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Keep products off ground using pallets, platforms, or other supports. Protect products from corrosion and deterioration.

B. Handling of Products:

1. Do not subject handrail and railing products to bending or stress.

2. Do not damage edges or handle products in a manner that will cause scratches, warping, or dents.

3. Protect handrails and railings by paper or coating as acceptable to handrail and railing manufacturer, against scratching, splashes of mortar, paint, and other marring during transportation, handling, and erection. Protect until completion of adjacent work.

1.06 GUARANTEE

A. Guarantee: Manufacturer shall provide written guarantee of availability of replacement parts and components for period of at least five years after completion of the Project.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. System Description: Aluminum handrail and railing system shall consist of equally spaced horizontal rails with totally concealed mechanical fasteners, internally threaded tubular rivets and components fastened to posts spaced no more than five feet on centers and system of handrails supported from adjacent construction by mounting brackets spaced at no more than five feet on centers.

B. System Description: Aluminum handrail and railing system shall consist of top and bottom rail with vertical pickets with totally concealed mechanical fasteners, internal threaded tubular rivets, and components fastened to posts spaced no more than five feet on centers and system of handrails supported from adjacent construction by mounting brackets spaced at no more than five feet on centers.

C. Design Criteria and Performance Criteria:

1. Design, fabricate, and install aluminum handrail and railing systems to withstand the most critical effects resulting from the following loads (loads listed below do not act concurrently):

a. Uniform Load: 50 pounds per foot, applied at top in any direction.

b. Concentrated Load: 200 pounds single load, applied at any point along the top in any direction.

c. Components: Intermediate rails (all rails except the handrail), balusters, and panel fillers, if any, shall withstand horizontally-applied normal load of 50 pounds on an area equal to one square foot, including openings and space between rails. Reactions due to this loading are not required to be superimposed to loading specified for main supporting members of handrails and railings.

d. Comply with AA Aluminum Design Manual for determining allowable stresses and safety factors for aluminum structural components.

e. Limit deflection in each single span of railing and handrail to 1.5-inch maximum, and to 1/4-inch maximum on railing posts. Applied loads shall not produce permanent deflection in the completed Work when loads are removed.

2. Thermal Control: Provide adequate expansion within fabricated systems that allows for thermal expansion and contraction caused by material temperature change of 140 degrees F to -20 degrees F without warp or bow of system components. Distance between expansion joints shall be based on providing 1/4-inch wide joint at 70 degrees F, which accommodates movement of 150 percent of calculated amount of movement for specified temperature range.

3. Where handrail and railing systems cross expansion joints in the building or structure, provide expansion joints in handrail and railings systems.

4. For posts located at or near end of runs as shown, uniformly space intermediate posts as required to conform to loading and deflection criteria specified, at intervals no greater than maximum post spacing specified. Where posts are shown for handrails along both sides of walkways and other similar locations, locate posts opposite each other; do not stagger post locations.

2.02 MANUFACTURERS

A. Products and Manufacturers: Provide one of the following:

1. Wesrail, by Moultrie Manufacturing Company.

2. Alumaguard, by Alumaguard – A division of Bettinger West, Inc.

3. Or equal.

2.03 MATERIALS

A. Extruded Aluminum Architectural and Ornamental Shapes: ASTM B221, Alloy 6063-T52.

B. Aluminum Forgings: ASTM B247.

C. Extruded or Drawn Aluminum Pipe and Tube:

1. ASTM B429 or ASTM B241/B241M, Alloy 6063-T5, 6063-T52, or 6063-T832 as required by loadings, deflections, and post spacing specified.

2. Provide Schedule 40 pipe, minimum, unless conditions of detail and fabrication require extra-heavy pipe to comply with Specifications. Rails and posts shall have minimum outside diameter of 1.90 inches.

D. Reinforcing Bars: Urethane foam-filled, Schedule 80, 23 inches long 6061-T6 aluminum reinforcing bars or tubes with outside diameter same as inside diameter of post.

E. Anchors and Fastenings:

1. For anchors and fasteners, use Type 316 stainless steel; minimum 3/8-inch diameter.

2. Provide minimum of four bolt fasteners per post where surface-mounted posts are shown. Components shall be in accordance with manufacturer's recommendations and as approved or accepted (as applicable) by ENGINEER on submittals.

3. Anchors: In accordance with Section 05 05 33, Anchor Systems.

F. Castings:

1. Provide high-strength aluminum alloy brackets, flanges, and fittings suitable for anodizing as specified.

2. Aluminum alloy sand castings: ASTM B26/B26M.

G. Connector Sleeves: Schedule 40, five-inch long by 1.610-inch diameter.

H. Sockets: Provide six-inch deep by 2.5-inch outside diameter aluminum sockets with 3.5-inch wide socket cover on bottom of each socket and on top and bottom of removable post sockets.

I. Gates: For each gate in handrail or railing system, provide the following:

1. Hinges: Two-self closing aluminum hinges.

2. Latches and Stops: One latch and stop with rubber bumper and one-inch diameter plastic knobs.

J. Custom Cover Flanges: 1/4-inch high by four-inch diameter, aluminum.

K. Non-shrink Grout: Comply with Section 03 60 00, Grouting.

L. Toeboards:

1. Provide extruded Alloy 6063-T5 or T52 aluminum alloy toeboards, unless railing is mounted on curbs or other construction of sufficient height and type to comply with OSHA 1910.23. Bars or plates are not acceptable.

2. Unless otherwise specified, toeboards shall comply with OSHA 1910.23, Section (e).

M. System Components and Miscellaneous Accessories: Provide complete selection of manufacturer's standard and custom aluminum handrail and railing systems components and miscellaneous accessories required. Show type and location of all such items on Shop Drawings and other submittals as applicable.

2.04 FABRICATION

A. General: Unless otherwise shown or specified, provide typical non-welded construction details and fabrication techniques recommended in NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501.

B. Fabricate handrail and railing systems true to line and level, with accurate angles surfaces and straight edges. Fabricate corners without using fittings. Provide bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends. Provide not less than four-inch outside radius.

C. Remove burrs from exposed edges.

D. Close aluminum pipe ends by using prefabricated fittings.

E. Weep Holes:

1. Fabricate joints that will be exposed to weather to exclude water.

2. Provide 15/64-inch diameter weep holes at lowest possible point on each post in handrail and railing systems.

3. Provide pressure relief holes at closed ends of handrail and railing systems.

F. Toeboards:

1. Provide manufacturer's standard toeboard, that accommodates movement caused by thermal change specified without warping or bowing toeboards.

2. Provide manufacturer's standard toeboard, which accommodates storage for removable socket covers.

3. Coordinate and cope toeboard as required to accommodate cover flanges at posts.

4. Toeboards shall follow curvature of railing. Where railing is shown to have curved contours at corners, or other locations, toeboard shall likewise be curved to follow line of railing system.

G. Reinforcing Bars: Provide reinforcing bar friction-fitted at each post in railing system. Extend reinforcing bars of tubes six inches into cast-in-place sleeves or other types of supporting brackets.

H. Mechanically Fitted Component Pipe Handrail and Railing System:

1. Use non-welded pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.

2. Provide top and two (2) intermediate horizontal rail(s), equally spaced.

3. Provide top and bottom rail with 0.675-inch diameter pickets spaced 1 feet on centers. Pressure fit pickets in shop fabricated channel adapters by hydraulic ram. Loose fit is not acceptable. Fasten picket sections into top and bottom rails by using tubular rivets 12 inches on centers maximum, but uniformly spaced between posts beginning 6.0 inches from centerline of post.

4. Use Type 304/305 stainless steel blind rivets and Type 304/305 stainless steel self-tapping screws in assembling components of the Work.

2.05 FINISHES

A. General:

1. Prepare surfaces for finishing in accordance with recommendation of aluminum producer and the aluminum finisher or processor.

2. Adjust and control direction of mechanical finishes specified to achieve best overall visual effect in the Work.

3. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for aluminum components. ENGINEER reserves the right to reject aluminum materials because of color or texture variations that are visually objectionable, but only where variation exceed range of variations established by manufacturer prior to fabrication, by means of range of Samples approved by ENGINEER.

4. Anodize aluminum components.

B. Finish:

1. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; AA Designation - M32 Medium Satin Directional Texture.

2. Hand-Rubbed Finish: Where required to complete the Work and provide uniform, continuous texture, provide hand-rubbed finish to match medium satin directional texture specified to even out and blend satin finishes produced by other means.

C. Cleaning:

1. Provide non-etching chemical cleaning by immersing aluminum in inhibited chemical solution, as recommended by coating applicator, to remove lard oil, fats, mineral grease, and other contamination detrimental to providing specified finishes.

2. Clean and rinse with water between steps as recommended by aluminum manufacturer.

D. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified that do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density, and acid electrolytes to obtain specified colors in compliance with designation system and requirements of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501. Comply with the following:

1. Provide Architectural Class I high density anodic treatment by immersing the components in tank containing solution of 15 percent sulfuric acid at 70 degrees F with 12 amperes per square foot of direct current for minimum of sixty minutes; AA Designation A41 Clear.

2. Physical Properties:

a. Anodic Coating Thickness, ASTM B244: Minimum of 0.7-mils thick.

b. Anodic Coating Weight, ASTM B137: Minimum of 32 mg/sq. in.

c. Resistance to Staining, ASTM B136: No stain after five minutes dye solution exposure.

d. Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.

3. Seal finished anodized coatings using deionized boiling water to seal pores and prevent further absorption.

4. Products and Manufacturers: Provide one of the following:

a. Alumilite 215 Clear by Aluminum Company of America, Inc.

b. Or equal.

2.06 SOURCE QUALITY CONTROL

A. Allowable Tolerances:

1. Limit variation of cast-in-place inserts, sleeves and field-drilled anchor and fastener holes to the following:

a. Spacing: Plus-or-minus 3/8-inch.

b. Alignment: Plus-or-minus 1/4-inch.

c. Plumbness: Plus-or-minus 1/8-inch.

2. Minimum Handrails and Railings Systems Plumb Criteria:

a. Limit variation of completed handrail and railing system alignment to 1/4-inch in 12 feet with posts set plumb to within 1/16-inch in 3.0 feet.

b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4-inch in 12.0 feet.

3. Provide “pencil-line” thin butt joints.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine conditions under which Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Verify to ENGINEER the gage of aluminum pipe railing posts and rails brought to the Site by actual measurement of on-Site material in presence of ENGINEER.

3.02 INSTALLATION

A. General:

1. Do not erect components that are scarred, dented, chipped, discolored, otherwise damaged, or defaced. Remove from Site railing and handrail system components that have holes, cuts, gouges, deep scratches, or dents of any kind. Repairs to correct such Work will not be accepted. Remove and replace with new material.

2. Comply with installation and anchorage recommendations of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501 in addition to requirements specified and approved or accepted (as applicable) submittals.

B. Fastening to In-Place Construction:

1. Remove protective plastic immediately before installing.

2. Adjust handrails and railings prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building or structure as follows:

a. Anchor posts to stair stringers with stringer or support flanges, angle type or floor type as required by conditions, shop-connected to posts and bolted to steel supporting members. Flanges shall be as recommended by manufacturer. Verify that reinforcing bars are inserted into posts before installation. Do not install posts without reinforcing bar.

b. Side-mount posts by fastening them securely in brackets attached to steel or concrete fascia as shown and in accordance with approved or accepted (as applicable) submittals.

c. Provide removable railing sections where shown. Provide removable railing system posts with friction-fitted reinforcing bar in each post. Provide sockets with socket covers stored in extruded toeboard. Provide aluminum pipe collars for all removable posts. Accurately locate sleeves to match post spacing.

d. Provide posts set in concrete with an aluminum floor cover flange.

3. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

C. Cutting, Fitting, and Placement:

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.

2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade surfaces of units that have been finished after fabrication, and are intended for field connections.

3. Make permanent field splice connections using stainless steel blind rivets and five-inch minimum length connector sleeves. Tight press-fit field splice connectors and install in accordance with manufacturer's written instruction. Install two blind rivets per joint on 180-degree centers.

4. Make splices as near as possible to posts, but not exceeding 12 inches from nearest post.

5. Field welding is not allowed. Make splices using pipe splice lock employing a single allen screw to lock joint.

6. Provide hinged gates as shown.

7. Secure handrails to walls with wall brackets and end fittings as shown. Drill wall plate portion of the bracket to receive one bolt, unless otherwise shown for concealed anchorage. Locate brackets as shown or, if not shown, at not more than five feet on centers. Provide flush type wall return fittings with same projection shown for wall brackets. Secure wall brackets and wall return fittings to building or structure. Refer to Section 05 05 33, Anchor Systems.

8. Securely fasten toeboards in place with not more than 1/4-inch clearance above floor level.

9. Drill one 15/64-inch diameter weep hole not more than 1/4-inch above top of location of solid reinforcing bar or tube in each post.

D. Fastening to Existing Construction:

1. Provide heavy-duty floor flange and anchorage devices and fasteners where necessary for securing handrail and railing systems components to existing

construction; including stainless steel threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required. Refer to Section 05 05 33, Anchor Systems.

2. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

E. Expansion Joints:

1. Provide slip joint with internal sleeve extending not less than two inches beyond joint on each side.

2. Construct expansion joints as for field splices, except fasten internal sleeve securely to one side of rail only.

3. Locate joints within six inches of posts.

F. Protection from Dissimilar Materials:

1. Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.

2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.03 CLEANING AND REPAIRING

A. Cleaning:

1. Clean exposed surfaces of handrail and railing systems after completion of installation. Comply with recommendations of both handrail and railing system manufacturer and finish manufacturer. Do not use abrasives or unacceptable solvent cleaners. Test cleaning techniques on an unused section of railing before employing cleaning technique.

2. Remove stains, dirt, grease, and other substances by washing handrails and railings systems thoroughly using clean water and soap; rinse with clean water.

3. Do not use acid solution, steel wool, or other harsh abrasives.

4. If stain remains after washing, remove defective sections and replace with new material complying with this Section.

B. Handrails and railings shall be free of dents, burrs, scratches, holes, and other blemishes. Replace damaged or otherwise defective Work with new material that complies with this Section at no additional cost to OWNER.

C. Prior to Substantial Completion, replace adjacent work marred by the Work of this Section.

END OF SECTION

SECTION 05 53 16

ALUMINUM GRATING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install aluminum grating and frames.

2. The Work includes:

a. Providing grating, frames, and appurtenances.

b. Providing openings in aluminum grating to accommodate the Work under this and other Sections, and attaching to aluminum grating all items such as sleeves, bands, studs, fasteners, and items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum grating Work.

C. Related Sections:

1. Section 09 91 00, Painting.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. AA Aluminum Design Manual.

2. ASTM B210, Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.

3. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

4. NAAMM MBG 531, Metal Bar Grating Manual.

5. NAAMM MBG 533, Welding Specifications for Fabrication of Steel, Aluminum and Stainless Steel Bar Grating.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have at least five years experience manufacturing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products and materials included in this Section regardless of component manufacturer from a single aluminum-grating manufacturer.

2. Aluminum grating manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all products and materials furnished under this Section.

3. Components shall be suitable for the specified service conditions and be integrated into overall assembly by aluminum grating manufacturer.

4. Provide only one type of aluminum grating exclusively throughout the Project.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Fabrication and erection of all Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.

b. Setting drawings and templates for location and installation of anchorage devices.

2. Product Data:

a. Manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.

2. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:

1. Protect materials from corrosion and deterioration.

2. Do not store materials in contact with concrete or other materials that might cause corrosion, staining, scratching, or damage materials or finish.

3. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. Aluminum Grating: Provide aluminum grating complying with the following:

1. Grating Design Loads: Uniform live load shall be as shown or indicated in the Contract Documents. Where live load is not shown or indicated, uniform live and concentrated loads shall be as indicated below, whichever results in the greater design stresses.

a. Live Load: 100 psf; Concentrated Load: 500 lbs per foot of grating width at center span.

2. Maximum Clear Span Deflection for Uniform Live Loads: 1/120 of span, but not more than 1/4-inch.

3. Maximum Fiber Stress: 12,000 psi.

4. Do not install aluminum grating in areas subject to vehicular traffic.

5. Minimum Size of Members:

a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable loading and deflection requirements.

b. Minimum dimensions of cross bars shall be as indicated in tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.

6. Banding bar shall be 1/4-inch thick minimum. Top of banding bar shall be flush with top of grating, unless otherwise shown or indicated. Banding bar shall be 1/4-inch shorter than the bearing bar height.

7. Comply with requirements of AA Aluminum Design Manual.

B. Stair Treads: Provide stair treads complying with the following:

1. Stair Tread Design Loads: Concentrated live load shall be:

a. 300 pounds on front-most five inches of tread at center of tread of span up to 5.5 feet.

b. 300 pounds on front-most five inches of tread at the one-third points of tread of span greater than 5.5 feet.

2. Maximum Clear Span Deflection for Concentrated Live Loads: 1/240 of span, but not more than 1/4-inch.

3. Maximum Fiber Stress: 12,000 psi.

4. Minimum Size of Members:

    a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable loading and deflection requirements.

    b. Minimum dimensions of cross bars shall be as indicated in tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.

5. Carrier plate shall be 1/4-inch thick minimum. Top of carrier plate shall be flush with top of tread, unless otherwise shown or indicated. Provide carrier plate with hole and slot for attachment to stringer.

6. Comply with requirements of AA Aluminum Design Manual.

2.02 MANUFACTURERS

A. Grating, Products and Manufacturers: Provide one of the following:

1. Swage-Locked I-Bar Grating, by IKG Industries.

2. Swage-Locked I-Bar Grating, by AMICO.

3. Or equal.

B. Stair Treads, Products and Manufacturers: Provide one of the following:

1. I-Bar Treads, by IKG Industries.

2. I-Bar Treads, by AMICO.

3. Or equal.

2.03 MATERIALS

A. Bearing Bars: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with ASTM B221.

B. Cross Bars or Bent Connecting Bars: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with either ASTM B221 or ASTM B210.

C. Frames: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with ASTM B221.

D. Stud anchors welded to steel supports and other fasteners shall be Type 316 stainless steel.

2.04 FABRICATION

A. Use materials of minimum depth and thickness specified and required to comply with performance criteria in the Contract Documents.

B. Provide grating as follows:

1. Grating Type: Aluminum I-bar with swage-locked cross bars at right angles to bearing bars.

2. Depth: One-inch minimum.

3. Bearing Bars: Aluminum I-bar minimum of one-inch spaced at 1-3/16-inch on centers.

4. Cross-Bars: Swage-locked to bearing bars at maximum spacing of four inches on centers.

5. Surface: Grooved.

6. Finish: Mill.

C. Provide stair treads as follows:

1. Tread Type: Aluminum I-bar with swage-locked cross bars at right angles to bearing bars.

2. Depth: One-inch minimum.

3. Bearing Bars: Aluminum I-bar minimum one-inch spaced at 1-3/16-inch on centers.

4. Cross Bars: Swage-locked to bearing bars at maximum spacing of four inches on centers.

5. Surface: Grooved.

6. Nosing: Cast aluminum abrasive nosing.

7. Finish: Mill.

D. Provide cutouts in grating for passage of piping, electrical conduit, valve stems, columns, ducts, and similar work. Where more than two bearings bars are included in a cut out, provide banding bars of same dimensions as bearing bars around opening welded to grating component parts.

E. Gratings shall be accurately fabricated, free from warps, twists, and other defects that would affect grating appearance and grating serviceability.

F. Welding shall conform to requirements of NAAMM MBG 533. Welds shall be ground smooth at top surfaces and bearing surfaces.

G. Openings in and edges of gratings sections shall be banded with banding bars. Weld bands to intersecting members.

H. Size each section of grating to weigh not more than 100 pounds, unless otherwise indicated in the Contract Documents.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions under which Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Check all dimensions at the Site after piping and equipment are in place and determine exact locations of openings and cutouts.

3.02 INSTALLATION

A. Fastening to In-Place Construction:

1. Use anchorage devices and fasteners to secure aluminum grating to supporting members or prepared openings, as recommended by manufacturer.

2. Weld Type 316 stainless steel stud bolts to receive saddle clip or flange block anchors to supporting steel members. Drill for machine bolts when supports are aluminum.

B. Cutting, Fitting, and Placing:

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true, and free of rack. Do not use wedges or shimming devices.

2. Where gratings are penetrated by piping, electrical conduit, ducts, structural members, or similar protrusions, cut openings neatly and accurately to size and attach banding bar as specified.

3. Divide panels into sections only to extent required for installation where aluminum grating is to be installed around previously installed piping, electrical conduit, ducts, structural members, or similar protrusions.

C. Aluminum gratings in concrete floors shall be removable and arranged in sizes to be readily lifted. Provide aluminum gratings in concrete with aluminum angle frames with mitered corners and welded joints. Grind exposed joints smooth. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected for flush fit.

D. Clearance at ends or between sections of grating shall be a maximum of 1/4-inch.

E. Tops of aluminum gratings shall be set flush with surrounding construction.

F. Aluminum gratings shall be set with full and uniform end bearing on frames to preclude rocking movement; do not use wedges or similar shimming devices.

G. Protection of Aluminum from Dissimilar Materials: Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel, or other metals, in accordance with Section 09 91 00, Painting.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 05 53 18

STAINLESS STEEL GRATING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install stainless steel grating and frames.

2. The Work includes:

a. Providing grating, frames, and appurtenances.

b. Providing openings in stainless steel grating to accommodate the Work under this and other Sections and attaching to stainless steel grating all items such as sleeves, bands, studs, fasteners, and items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before stainless steel grating Work.

C. Related Sections:

1. None

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ASTM A276, Specification for Stainless Steel Bars and Shapes.

2. ASTM A666, Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

3. NAAMM MBG 531, Metal Bar Grating Manual.

4. NAAMM MBG 533, Welding Specifications for Fabrication of Steel, Aluminum and Stainless Bar Grating.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have at least five years experience manufacturing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of component manufacturer from a single stainless steel grating manufacturer.

2. Stainless steel grating manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the stainless steel grating manufacturer.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Fabrication and erection of all stainless steel gratings Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.

b. Setting drawings and templates for location and installation of anchorage devices.

2. Product Data:

a. Manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading:

1. Deliver products to the Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.

2. Comply with Section 01 65 00, Product Delivery Requirements

B. Storage and Protection:

1. Protect materials from corrosion and deterioration.

2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. Stainless Steel Grating: Provide stainless steel grating complying with the following:

1. Grating Design Loads: Uniform live load shall be as shown or indicated in the Contract Documents. Where live load is not shown or indicated, uniform live and concentrated loads shall be as indicated below, whichever results in the greater design stresses:

    a. Live Load: 100 psf; Concentrated Load: 500 lbs per foot of grating width at center span.

2. Maximum Clear Span Deflection for Uniform Live Loads: 1/120 of span, but not more than 1/4-inch.

3. Maximum Fiber Stress: 20,000 psi.

4. Minimum Size of Members:

    a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable loading and deflection requirements.

    b. Minimum dimensions of cross bars shall be as indicated in the tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.

5. Banding bar shall be 1/4-inch thick minimum. Top of banding bar shall be flush with top of grating, unless otherwise shown or indicated. Banding bar shall be 1/4-inch shorter than bearing bar height.

B. Stair Treads: Provide stainless steel stair treads complying with the following:

1. Stair Tread Design Loads: Concentrated live load shall be:

    a. 300 pounds on front five inches of tread at center of tread span of up to and including 5.5 feet.

    b. 300 pounds on front five inches of tread at one-third points of tread span of greater than 5.5 feet.

2. Maximum Clear Span Deflection for Concentrated Live Loads: 1/240 of span, but not more than 1/4-inch.

3. Maximum Fiber Stress: 20,000 psi.

4. Minimum Size of Members:

    a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable loading and deflection requirements.

b. Minimum dimensions of cross bars shall be as shown on the tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.

5. Carrier plate shall be 1/4-inch thick minimum. Top of carrier plate shall be flush with top of tread, unless otherwise shown or indicated. Provide carrier plate with hole and slot for attaching to stringer.

2.02 MANUFACTURERS

A. Grating, Products and Manufacturers: Provide one of the following:

1. Weldforged Stainless Grating, manufactured by IKG Industries.

2. Electroforged Stainless Grating, manufactured by McNichols Company.

3. Or equal.

B. Stair Treads, Products and Manufacturers: Provide one of the following:

1. Weldforged Stainless Treads, manufactured by IKG Industries.

2. Electroforged Stainless Treads, manufactured by McNichols Company.

3. Or equal.

2.03 MATERIALS

A. Stainless steel used in bearing bars and cross bars shall be Type 316 alloy complying with ASTM A666.

B. Frames: Stainless steel complying with ASTM A276, Type 316.

2.04 FABRICATION

A. Use materials of minimum depth and thickness as specified and required to comply with performance criteria in the Contract Documents.

B. Provide grating as follows:

1. Grating Type: Welded rectangular bearing bars with cross bars resistance-welded at right angles to bearing bars.

2. Depth: One-inch, minimum.

3. Bearing Bars: Minimum one-inch by 3/16-inch spaced at 1-3/16-inch on centers.

4. Cross Bars: Welded to bearing bars at maximum spacing of four inches on centers.

5. Surface: Plain.

6. Finish: Mill.

C. Provide stair treads as follows:

1. Tread Type: Welded rectangular bearing bars with cross bars resistance-welded at right angles to bearing bars.

2. Depth: One-inch, minimum.

3. Bearing Bars: Minimum one-inch by 3/16-inch spaced at 1-3/16-inch on centers.

4. Cross Bars: Welded to bearing bars at spacing not greater than of four inches on centers.

5. Surface: Plain.

6. Nosing: Cast aluminum abrasive nosing.

7. Finish: Mill.

D. Provide cutouts in grating for passage of piping, electrical conduits, valve stems, columns, ducts, and similar work. Where more than two bearings bars are included in a cut out, provide banding bars of same dimensions as bearing bars around opening welded to grating component parts.

E. Gratings shall be accurately fabricated, free from warps, twists or other defects that would affect grating appearance and grating serviceability of the grating.

F. Tops of grating bearing bars and cross bars shall be in the same plane.

G. Welding shall comply with NAAMM MBG 533. Welds shall be ground smooth at top and bearing surfaces.

H. Openings in and edges of grating sections shall be banded with flat banding bars as specified in this Section, welded along the line of cutout or to end of grating panel.

I. Size each section of grating to weigh maximum of 150 pounds, unless otherwise indicated in the Contract Documents.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine conditions under which Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Check all dimensions at the Site after piping and equipment are in place and determine exact locations of openings and cutouts.

3.02 INSTALLATION

A. Fastening to In-Place Construction:

1. Use anchorage devices and fasteners to secure stainless steel grating to supporting members or prepared openings, as recommended by manufacturer.

2. For grating having bearing bars at 1-3/16-inch centers or greater, provide four saddle clip stainless steel anchors designed to fit over two bearing bars, and four stainless stud bolts with stainless washers and nuts for each grating panel, unless otherwise shown or indicated. For bearing bars spacing less than 1-3/16-inch centers, provide anchors in accordance with manufacturer's recommendations.

B. Cutting, Fitting, and Placing:

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true, and free of rack. Do not use wedges or shimming devices.

2. Where gratings are penetrated by piping, electrical conduits, ducts, structural members, or similar protrusions, cut openings neatly and accurately to size and attach banding bar as specified.

3. Divide panels into sections only to extent required for installation where stainless steel grating is to be installed around previously installed piping, electrical conduits, ducts, structural members, or similar protrusions.

C. Stainless steel gratings in concrete floors shall be removable and shall be arranged in sizes to be readily lifted. Provide stainless steel gratings in concrete with stainless steel angle frames having mitered corners and welded joints. Grind exposed joints smooth. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected for flush fit.

D. Clearance at ends or between sections of stainless steel grating shall be not greater than of 1/4-inch.

E. Tops of stainless steel gratings shall be set flush with surrounding construction.

F. Stainless steel gratings shall be set with full and uniform end bearing on frames to preclude rocking movement; do not use wedges or similar shimming devices.

G. Remove stains, cement droppings, oils, dirt, grease, paint, and other foreign matter.

END OF SECTION

SECTION 05 54 63

FLOOR ACCESS HATCH COVERS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install floor access hatch covers.

2. The Work also includes:

a. Providing openings in and attachments to floor access hatch covers to accommodate the Work under this and other Sections, and providing for floor access hatch covers items such as anchorage devices, and all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items to be installed with or before floor access hatch covers Work.

C. Related Sections:

1. Section 09 91 00, Painting.

1.02 REFERENCES

A. Standards referenced in this Section:

1. AASHTO Standard Specifications for Highway Bridges.

2. MIL-P-21035B, Military Specification, Paint, High Zinc Dust Content Galvanizing Repair.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

a. Manufacturer shall have not less than five years experience producing products substantially similar to those specified and, upon ENGINEER's request, shall submit documentation of not less than five satisfactory installations in place for not less than five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of the component manufacturer from a single floor access hatch covers manufacturer. Furnishing covers from more than one manufacturer is unacceptable.

2. Floor access hatch covers manufacturer shall prepare, or shall review and approve, all Shop Drawings and other submittals for all components furnished under this Section.

3. Components shall be suitable for specified service conditions and shall be integrated into the overall assembly by the floor access hatch covers manufacturer.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Detailed plans and other drawings showing location of products and direction of door swing; floor access hatch cover schedules indicating cover location, material, type, loading capacity, and other information; and fabrication details for the access hatch covers Work, including materials, thickness of metals, finishes, latching or locking provisions, type of anchorages, and accessory items.

2. Product Data:

a. Copies of manufacturer's literature and specifications for each type of floor access hatch incorporated in the Work.

B. Informational Submittals: Submit the following:

1. Supplier Instructions:

a. Installation data, including setting drawings and templates.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping:

1. Protect mill finish and other finish during shipping and installation by an attached, adhesive-backed vinyl material that is removable during and after installation of the access hatch cover.

B. Storage and Protection:

1. Protect steel members and packaged materials from corrosion and deterioration.

1.06 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. The obligations of CONTRACTOR under the Contract

Documents shall not be limited in any way by the provisions of the specified special warranty.

B. Special Warranty:

1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace structural components of the products specified in this Section found to have defect in material and workmanship during a period of five years after the date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL

A. General:

1. Provide manufacturer's standard fabricated access hatch cover units, modified when necessary to comply with the Contract Documents. Where standard units are not available for the sizes and types required, provide custom-fabricated units of the same quality as manufacturer's similar standard-sized units.

2. Fabricate each access hatch cover unit in the shop, complete with anchors, gaskets, hardware, and accessory items, as required.

2.02 CHANNEL-FRAME TYPE ACCESS HATCH COVERS

A. Aluminum Floor Access Hatch Covers – Channel Frame Type:

1. Design Live Load: 300 pounds per square foot.

2. Products and Manufacturers: Provide one of the following:

a. Single-Leaf Door Aluminum Access Hatch Cover:

1) Model TPS, by U.S.F Fabrication, Inc.

2) Type J-AL, by The Bilco Company.

3) Or equal.

b. Double-Leaf Door Aluminum Access Hatch Cover:

1) Model TPD, by U.S.F. Fabrication, Inc.

2) Type JD-AL, by The Bilco Company.

3) Or equal.

3. Cover: Not less than 1/4-inch thick, aluminum diamond-pattern plate cover. Provide flush drop-handle for lifting the cover.

4. Frame: Extruded aluminum channel frame with manufacturer's standard anchor tabs or continuous anchor flange around perimeter for anchorage to concrete.

5. Drain Coupling: 1.5-inch diameter NPT threaded drain coupling welded under the channel frame for connection of a drain pipe.

6. Gasket: EPDM gasket mechanically attached to the channel frame.

7. Hinges: Type 316 stainless steel, heavy-duty butt hinges with Type 316 stainless steel pin fastened to door with Type 316 stainless steel tamper-resistant bolts.

8. Latch: Type 316 stainless steel, watertight, slam-type latch with inside lever handle and outside removable exterior turn/lift handle fastened to leaf (door) with tamper-resistant Type 316 stainless steel bolts. Latch release shall be protected by a flush, gasketed, removable screw plug.

9. Lift Assistance: Open-style stainless steel compression springs with Type 316 stainless steel guide tubes. Automatic Type 316 stainless steel hold-open arm with grip handle release.

10. Fall-Through Prevention System: Provide access hatch cover manufacturer's standard safety grating of FRP or aluminum, constructed for live load capacity of not less than 300 psf. Provide hinges and lift-assist to allow grating sections to automatically lock in place in full-open 90-degree position. Provide hold-open arm and release assembly of aluminum or Type 316 stainless steel. Grating shall be colored OSHA "Safety Yellow" or "Safety Orange".

11. Finish: Mill finish.

B. Aluminum Floor Access Hatch Covers (H-20 Loading) – Channel Frame Type:

1. Design Live Load: H-20 truck loading in accordance with AASHTO Standard Specifications for Highway Bridges, intended for use in off-street locations that may occasionally be subject to H-20 wheel loads.

2. Products and Manufacturers: Provide one of the following:

a. Single-Leaf Door Aluminum Access Hatch Cover:

1) Model THS, by U.S.F Fabrication.

2) Type J-AL H-20, by The Bilco Company.

3) Or equal.

b. Double-Leaf Door Aluminum Access Hatch Cover:

1) Model THD, by U.S.F Fabrication.

2) Type JD-AL H-20, by The Bilco Company.

3) Or equal.

3. Cover: Not less than 1/4-inch thick, aluminum diamond-pattern plate cover with stiffener plates, as required. Provide flush drop-handle for lifting the cover.

4. Frame: Extruded aluminum channel frame with manufacturer's standard anchor tabs or continuous anchor flange around the perimeter for anchorage to concrete.

5. Drain Coupling: 1.5-inch diameter NPT threaded drain coupling welded under the channel frame for connection of a drain pipe.

6. Gasket: EPDM gasket mechanically attached to the channel frame.

7. Hinges: Type 316 stainless steel, heavy-duty butt hinges with Type 316 stainless steel pin fastened to door with Type 316 stainless steel tamper resistant bolts.

8. Latch: Type 316 stainless steel, watertight, slam-type latch with inside lever handle and outside removable exterior turn/lift handle fastened to leaf (door) with tamper-resistant Type 316 stainless steel bolts. Latch release shall be protected by a flush, gasketed, removable screw plug.

9. Lift Assistance: Open-style stainless steel compression springs with Type 316 stainless steel guide tubes. Automatic Type 316 stainless steel hold-open arm with grip handle release.

10. Fall-Through Prevention System: Provide access hatch cover manufacturer's standard safety grating of FRP or aluminum, constructed for live load capacity of not less than 300 psf. Provide hinges and lift-assist to allow grating sections to automatically lock in place in full-open 90-degree position. Provide hold-open arm and release assembly of aluminum or Type 316 stainless steel. Grating shall be colored OSHA "Safety Yellow" or "Safety Orange".

11. Finish: Mill finish.

C. Provide Schedule 40 PVC drain piping from the floor access hatch cover channel frame routed as indicated in the Contract Documents.

2.03 ANGLE-FRAME TYPE ACCESS HATCH COVERS

A. Aluminum Floor Access Hatch Covers – Angle Frame Type:

1. Design Live Load: 300 pounds per square foot.

2. Products and Manufacturers: Provide one of the following:

a. Single-Leaf Door Aluminum Access Hatch Cover:

1) Model APS300, by U.S.F. Fabrication, Inc.

2) Type K, by The Bilco Company.

3) Or equal.

b. Double-Leaf Door Aluminum Access Hatch Cover:

1) Model APD300, by U.S.F. Fabrication, Inc.

2) Type KD, by The Bilco Company.

3) Or equal.

3. Cover: Not less than 1/4-inch thick aluminum diamond-pattern plate cover. Provide flush drop handle for lifting the cover.

4. Frame: Extruded aluminum angle frame with manufacturer's standard anchor tabs or continuous anchor flange around the perimeter for anchorage to concrete.

5. Hinges: Tamper-resistant, heavy-duty hinges with Type 316 stainless steel pin fastened to leaf (door) with Type 316 stainless steel tamper-resistant bolts.

6. Latch: Type 316 stainless steel, watertight, slam-type latch with inside lever handle and outside, removable exterior turn/lift handle fastened to leaf (door) with tamper-resistant Type 316 stainless steel bolts. Latch release shall be protected by a flush, gasketed, removable screw plug.

7. Lift Assistance: Open-style stainless steel compression springs with Type 316 stainless steel guide tubes. Automatic Type 316 stainless steel hold-open arm with grip handle release.

8. Finish: Mill finish.

B. Stainless Steel Floor Access Hatch Covers – Angle Frame Type:

1. Design Live Load: 300 pounds per square foot.

2. Products and Manufacturers: Provide one of the following:

a. Single-Leaf Door Stainless Steel Access Hatch Cover:

1) Model APS300, by U.S.F. Fabrication, Inc.

2) B-FHA Series Single Leaf, by Babcock Davis Associates, Inc.

3) Or equal.

b. Double-Leaf Door Stainless Steel Access Hatch Cover:

1) Model APD300, by U.S.F. Fabrication, Inc.

2) B-FHA Series Double Leaf, by Babcock Davis Associates, Inc.

3) Or equal.

3. Cover: Not less than 1/4-inch thick, Type 316 stainless steel diamond-pattern plate cover. Provide flush drop-handle for lifting the cover.

4. Frame: Type 316 stainless steel angle frame with manufacturer's standard anchor tabs or continuous anchor flange around the perimeter for anchorage to concrete.

5. Hinges: Tamper-resistant, heavy-duty hinges with Type 316 stainless steel pin fastened to leaf (door) with Type 316 stainless steel tamper-resistant bolts.

6. Latch: Type 316 stainless steel, watertight, slam-type latch with inside lever handle and outside removable exterior turn/lift handle fastened to leaf (door) with tamper-resistant Type 316 stainless steel bolts. Latch release shall be protected by a flush, gasketed, removable screw plug.

7. Lift Assistance: Open-style stainless steel compression springs with Type 316 stainless steel guide tubes. Automatic Type 316 stainless steel hold-open arm with grip handle release.

8. Finish: Type 316 stainless steel.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which floor access hatch cover Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install floor access hatch covers in accordance with approved Shop Drawings and other approved submittals, the Contract Documents, and manufacturer's instructions.

B. Set floor access hatch covers level and true to line or grade, without warp or rack.

C. Drain Piping for Channel Frames:

1. Provide drain piping from the floor access match cover channel frame routed as shown or indicated on the Drawings.

2. Provide drain piping from the floor access hatch cover channel frame and route to the nearest floor drain or sump pit in a manner that does not obstruct access for facility operations and maintenance.

3. After installation, fill drain piping with water. Drain piping shall be free of visible leaks.

D. Protection of Aluminum from Dissimilar Materials: Coat surfaces of aluminum in contact with dissimilar materials such as concrete, masonry, steel, and other metals in accordance with Section 09 91 00, Painting.

3.03 ADJUSTING AND CLEANING

A. Adjust leafs of floor access hatch covers as necessary to provide proper operations.

B. Remove stains, concrete splatter, oils, grease, and other foreign materials necessary and provide clean, finished surfaces.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Treated wood members.

B. Plywood.

C. Wood blocking, nailers, furring, and Grounds.

D. Rough Hardware, nails bolts, washers, and other fastening devices.

E. Sheathing materials and fasteners.

1.03 RELATED WORK

A. Section 06 22 00 – Finish Carpentry.

B. Section 08 11 00 – Metal Doors and Frames.

1.04 REFERENCES

A. American Lumber Standards Committee (ALSC):

1. Softwood Lumber Standards.

B. American Plywood Association (APA):

1. Grades and Standards.

C. American Society for Testing and Materials (ASTM):

1. ASTM A307 – Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
2. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.

D. American Wood Preservers Association (AWPA):

1. AWPA – C1 – All Timber Products – Preservative Treatment by Pressure Process.
2. AWPA – C15 – Wood for Commercial-Residential Construction Preservative Treatment by

Pressure Processes.
3. AWPA – C20 – Structural Lumber – Fire-Retardant Treatment by Pressure Processes.
4. AWPA – C27 – Plywood – Fire-Retardant Treatment by Pressure Processes.
5. AWPA – P5 – Water Borne Preservatives.

E. Underwriters' Laboratories, Inc. (UL):

1. UL FR S – Fire-Rated Treated Wood with Flame Spread and Smoke Developed Ratings of 25 or less in accordance with ASTM E84.
2. UL 723 – Test for Surface Burning Characteristics of Building Materials.

1.05 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Procedures for submittals.
1. Certificates:
   a. Pressure-Treated Wood: Certification from treating plant stating chemicals and process used and net amount of preservatives retained are in conformance with specified standards.
   b. Preservative-Treated Wood: Certification for water-borne preservative that moisture content was reduced to 19% maximum, after treatment.
   c. Fire-Retardant Treated Wood: Certification from treating plant stating that fire-retardant treatment materials comply with governing code, ordinances and requirements of local authority having jurisdiction, and treatment will not bleed through finished surfaces.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by ALSC.
2. Plywood Grading Agency: Certified by APA.

B. Regulatory Requirements: Conform to applicable codes for fire-retardant treatment of wood surfaces for flame/smoke ratings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Material and Equipment: Transport, handle, store, and protect products.

1. Inspect wood materials for conformance to specified grades, species, and treatment at time of delivery to project site.
2. Reject and return unsatisfactory wood materials.

B. Provide facilities for handling and storage of materials to prevent damage to edges, ends and surfaces.

C. Keep materials dry. Stack materials off ground minimum 12" or, if on concrete slab-on-grade, minimum 1-1/2", fully protect from weather. Provide for air circulation within and around stacks and under temporary coverings.

D. For materials pressure-treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Environmental Impact: Comply with applicable regulations regarding toxic and hazardous materials.

1. Formaldehyde: Products containing urea-formaldehyde will not be permitted.
2. Wood pressure treatment products: Products containing chromium will not be permitted. Products containing arsenic will not be permitted.

PART 2 – PRODUCTS

2.01 MATERIALS

A. No. 2 Grade, finished 4 sides, 15% maximum moisture content. Each piece of lumber to be factory marked with type, grade, mill, and grading agency.

B. Nailers, Blocking, Furring and Sleepers:

1. Pressure preservatives treat items in contact with roofing, flashing, waterproofing, masonry, concrete or the ground.
2. All interior wood, blocking, and wood used at roof shall be treated with fire retardant to obtain a flame spread rating of 25 or less when tested according to ASTM E-84. Treat cuts, etc. as recommended by manufacturer of flame-retardant materials.

C. All interior lumber and all roof deck lumber to be used for framing, blocking, furring shall be SPIB or WCLB treated with fire retardant to obtain flame spread rating of 25 or less when tested according to ASTM E-84. Treat cuts, etc. as recommended by manufacturer of flame retardant materials.

2.02 SHEATHING MATERIALS

A. Plywood, APA exterior type, rated for use:

1. Backing panels: APA C-D plugged 3/4”-thick, exterior type.

2.03 FASTENERS

A. Fasteners: Provide manufacturer’s recommended power tools for each type of fastener.

1. Bolts, Nuts, Washers, Lag Screws, and Wood Screws: ASTM A307, medium carbon steel; size and type to suit application; galvanized for treated wood. Size and type to suit application, unless otherwise noted.
2. Expansion Shield Fasteners: For anchorage of non-structural items to solid masonry and

concrete.

3. Powder or Pneumatically Activated Fasteners: For anchorage of non-structural items to steel.

2.04 WOOD TREATMENT

A. Preservative Pressure Treated Lumber:

1. Manufacturers:
   a. ACQ Preserve Type Bor Type "D" by Chemical Specialties, Inc., (800) 421-8661 or (704) 522-0825.
2. Impregnate lumber with preservative treatment conforming to AWPA Standard C1, C2, C22, and P5. Apply the preservative in a closed cylinder by pressure process in accordance with AWPA Standard C15.
3. Retention of preservatives:
   a. Moderate service conditions (weather exposure): 0.25 pounds per cubic foot (oxide basis).
   b. Severe conditions (constant contact with ground or water): 0.40 pounds per cubic foot (oxide basis).
4. Remove excess moisture where shrinkage is a serious fault or where treated lumber will be in contact with plaster, or stucco, and where waterborne treated lumber is to be painted or stained.
5. Lumber shall be dried to 15-19% moisture content after treatment, and material to be painted or stained shall have knots and pitch streaks sealed as with untreated wood.
6. Liberally brush freshly cut surfaces, bolt holes and machined areas with the compatible preservative in accordance with preservative manufacturer's recommendations.

B. Fire-Retardant Treatment:

1. Manufacturers:
   a. "Dricon" by Hickson Corporation; Atlanta, GA; (404) 801-6600.
   b. "Pyro-Guard" by Hoover Treated Wood Products, Inc.; Thomson, GA; (800)832-9663.
   c. "D-Blaze" by Chemical Specialties, Inc., (800) 421-8661 or (704) 522-0825.
2. Lumber and plywood shall be treated as follows:
   a. Each piece of treated material shall bear the UL FR-S rating (flamespread and smoke developed less than 25) indicating compliance with an extended 30-minute tunnel test in accordance with ASTM E84 or UL 723.
   b. After treatment, all lumber shall be dried to an average moisture content of 19% or less.
   c. After treatment, all plywood, shall be dried to an average moisture content of 15% or less.
   d. All treated material shall meet interior Type A requirements in AWPA standard C-20 for lumber and C-27 for plywood.
   e. Chemicals used to treat material shall be free of halogens, sulfates, ammonium phosphate and formaldehyde.
   f. Treatment material shall provide protection against termites and fungal decay and shall be registered for use as a wood preservative by the U.S. Environmental Protection Agency.

C. Wood Requiring Treatment:

1. Lumber, Preservative Treated: Nailers, blocking, stripping, and similar items in conjunction

with roofing, flashing, and other construction. Sills, blocking, furring, stripping, and similar items in contact with masonry or concrete.

2. Lumber, Fire-Retardant Treated: Interior framing, furring, blocking, nailers, and miscellaneous exposed wood.
3. Interior Plywood, Fire-Retardant Treated: Plywood backing for electrical and telephone equipment.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work.

1. Verify that spacing, direction, and details of supports are correct to accommodate installation of blocking, backing, stripping, furring and nailing strips.

B. Report in writing, to the Architect, conditions that will adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

C. By beginning work, the contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost.

3.02 INSTALLATION – FRAMING

A. Set structural members level and plumb, in correct position.

B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Place horizontal members, crown side up.

D. Construct load bearing framing and curb members full length without splices.

E. Place full width continuous sill flashings under framed walls on cementitious foundations. Lap flashing joint 4”.

F. Place sill gasket directly on sill flashing. Puncture gasket clean and fit tight to protruding foundation anchor bolts.

G. Install miscellaneous blocking, nailing strips and framing where required as backing for attachment of wall mounted fixtures, Door and Window (and other openings) frames, cabinetwork, and other items, and as detailed on drawings. Coordinate to allow proper attachment of work of other sections.

1. Secure in place using fasteners specified. Use only recommended power tools for placement

of fasteners.

2. Recess heads of fasteners below surface of wood members.

H. Secure in place with appropriate fasteners. Use fasteners of correct size that will not penetrate members where opposite side will be exposed to view or require finishing. Do not split wood with fasteners; set panel products to allow expansion at joints.

I. Construct members of continuous pieces of longest possible lengths.

3.03 INSTALLATION – PLYWOOD

A. Secure backing with longer edge perpendicular to framing members and with ends staggered and sheet ends over bearings.

B. Place building paper horizontally over wall sheathing; weather lap edges and ends.

C. Install telephone and electrical panel back boards with plywood sheathing material where required. Size the back board by 12" beyond size of electrical panel.

3.04 SITE TREATMENT OF WOOD MATERIALS

A. Apply preservative treatment in accordance with manufacturer's published instructions.

B. Brush apply two coats of preservative treatment on wood in contact with cementitious materials and roofing and related metal flashings. Treat site-sawn cuts.

C. Allow preservative to dry prior to erecting members.

3.05 FIELD QUALITY CONTROL

A. Section 01 45 29 – Quality Control: Field inspection.

B. Framing Inspection:

1. Inspect wood blocking, nailers, and furring installation and connections at completion of each phase of construction for correct installation, nailing, connections, and fasteners.

C. Performance:

1. Work shall be performed in conformance with good trade practice, recommendations of manufacturers, building codes and these specifications unless specifically indicated otherwise on the drawings and shall be well fitted and securely fastened in its proper location with nails, screws, bolts, or other approved fastening devices.

END OF SECTION

SECTION 06 22 00
FINISH CARPENTRY AND MILLWORK

PART 1 – GENERAL

1.01 QUALITY ASSURANCE

A. Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI), except as otherwise indicated.

B. Installer Qualifications: Arrange for installation of architectural woodwork by a firm which can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this project.

1.02 WORK INCLUDED

A. Cabinets, base units, wall cabinets, shelves, counter tops.

B. Cabinet Hardware.

1.03 RELATED WORK

A. Section 06 10 00 – Rough carpentry.

B. Section 09 90 00 – Painting.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each product and process specified as work of this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

B. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.

C. Shop Drawings: Submit shop drawing showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.

D. Samples: Submit the following samples:

1. Plastic laminate, 8" x 10" for each type, color pattern and surface finish.
2. Exposed cabinet hardware, one unit of each type and finish.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect woodwork and plastics during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

1.06 PROJECT CONDITIONS

A. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0% tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Refer to manufactures listed on the finish schedule. Subject to compliance with substitution requirements, other manufacturers offering high pressure decorative laminates may be considered.

2.02 FABRICATION, GENERAL

A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.

B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and items and work.

1. Ease edges to a 1/16" radius, for corners of laminate clad cabinets.
2. Provide base, wall and full height units with drawer fronts, doors and fixed panels overlaying and concealing frames and sides of cabinet bodies.

C. Pre-Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with an opaque water-resistant coating to match adjacent laminate.

D. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.03 ARCHITECTURAL MILLWORK

A. General: Except as otherwise indicated, comply with the following requirements for architectural woodwork not specifically indicated as prefabricated or prefinished standard products.
B. Wood Moisture Content: Provide kiln-dried (KD) lumber with an average moisture content range of 6% to 11%. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed the following:

1. Interior Wood Finish: 5%-10% for mild regions (as defined by AWI).

C. Veneer Matching: To be determined by Fabricator, for best visual effect, depending upon flitch width and grain character. Refer questions about best visual effect to the Architect for resolution as work progresses.

D. Plastic Laminate: Comply with NEMA LD-3 for type, thickness, color, pattern and finish indicated for each application, or if not indicated, as selected by Architect from manufacturer's standard products.

E. Quality Standards: For following types of architectural woodwork; comply with indicated standards as applicable.
1. Standing and Running Trim: AWI Section 300.
2. Casework and Countertops: AWI Section 400.
3. Shelving: AWI Section 600.
4. Miscellaneous Work: ASI Section 700.

F. Design and Construction Features: Comply with details shown for profile and construction of architectural woodwork; and, where not otherwise shown, comply with applicable Quality Standards, with alternate details as Fabricator's opinion.

G. Pre-Cut Openings: Fabricate architectural woodwork with pre-cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water-resistant coating.

H. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.04 HARDWARE

A. All cabinet hardware shall be furnished and installed by the fabricator.

B. Hardware to be as follows:

1. Drawer guide – K & V #1300, length as required, and capacity of 75 lbs. per pair or approved equal.
2. Shelf Standards and Brackets where indicated on drawings.
   a. For base or wall cabinets use Knape & Vogt Mfg. Co. No. 255NP Standards (recessed) with No. 256R supports for wood shelves or approved equal.
   b. For opening shelving use Knape & Vogt Mfg. Co. heavy duty No. 82 Nat Standards with No. 182 Nat Brackets or approved equal – size as indicated on drawings – 12", 14", 18" or 24"
3. Hinges: Two (2) hinges per door under 30" in height and a maximum of 24" in width and 3/4" thick. Hinges shall be equal to "Grass 3903".

4. Catches: Stanley Magnetic Cabinet Catch No. 41, Finish US28, one per door or approved equal.
5. Pulls: Haefele #117.31.436 or approved equal.
6. Drawer and Door Locks: Equal to "Timberline" Cam Lock CB-180 Series. Locations as indicated on drawings. If none are indicated, then bid on half of the cabinets and drawers receiving locks and request locations during submittals
7. Grommets: flush mounted brushd aluminum grommet – 1 1/2 In Dia, x thickness of countertop, include one at each work station or every 5' and request / confirm location during submittals
8. Countertop support bracket – equal to Rakks EH Inside Wall Mount support brackets for 24" and 30" deep countertops, length / depth as needed for maximum support (min 300 lbs per bracket). Install per manufacture recommendations to solid wall support or blocking as directed by manufacture, spaced as directed by manufacture with minimum spacing of 48" in order to maximize weight capacity. Install with double stud wood blocking (wood blocking each side of each metal stud) per manufactures recommendation concealed inside wall. Support bracket shall be powder coated black

2.05 FASTENERS AND ANCHORS

A. Screws: Select material, type, size and finish required for each use. Comply with FS FF-S-111 for applicable requirements.

1. For metal framing supports, provide screws as recommended by metal framing manufacturer.

B. Nails: Select material, type, size and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

C. Anchors: Select material, type, size and finish required by each substrate for secure anchorage. Provide non-ferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion-resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

PART 3 – EXECUTION

3.01 WORKMANSHIP

A. Interior woodwork shall have a fine, smooth finish, and be free from machine or tool marks, abrasions and raised grain on exposed surfaces.

B. Joints shall be tight and so formed as to concealed shrinkage. Shop joints shall be glued under pressure.

C. Set wood finish straight, plumb or level, in true alignment, with closely fitted joints, and rigidly fastened in place. Nailing and fastening shall be concealed where possible and exposed nail heads shall be set for puttying.

3.02 MILLWORK

A. The minimum standard for millwork construction shall be Custom Grade conforming to AWI Section 400 and as specified. The type of construction shall be reveal overlay with a face frame or Frameless with a maximum gap between doors of 1/8 in.

B. Definitions:

1. Exposed portions of cabinets shall include all surfaces visible when doors are closed. All visible members in open cases shall be considered as exposed portions.
2. Semi-exposed portions of cabinets shall include these members behind opaque doors, such as shelves, divisions, interior faces of ends, cabinet backs and bottoms.
3. Concealed portions of cabinets shall include sleepers, web frames and other surfaces not usually visible after installation.

C. Exposed surfaces and edges shall be free from defects; face material shall be closely matched and joined, and no raw plywood edges shall show on finished work. Where plywood edges occur, they shall be edged with material of same grade and species as the finish wood of the remainder of the work.

D. All exposed surfaces shall be sanded to even smooth surfaces ready for hand finishing.

E. All light fixtures, electric outlets, telephone outlets, etc., to be furnished and installed by the Electrical Contractor. Cutouts for these items to be made by millwork contractor. Millwork contractor to install removable panels at knee spaces where indicated on drawings in order that working space be accessible to Electrical Contractor.

F. All plumbing fixtures in connection with this section shall be furnished and installed by the Mechanical contractor. Cutouts to be made by millwork contractor.

G. Surfaces and edges that are to receive plastic laminate finish shall have a smooth, clean surface free from defects.

H. All work shall be shop assembled insofar as practicable. Work shall be delivered, ready for erection, with ample allowances for scribing, cutting and fitting. Units shall be accurately located, erected plumb, level, square and in correct alignment and proper elevation with other work.

3.03 MISCELLANEOUS WOOD AND PLASTIC ITEMS

Miscellaneous wood and plastic items shall be provided where indicated on the drawings. Use materials as specified under Part 2 – Products. Install all items straight, without twist, and securely fastened in place.

3.04 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas prior to

installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

C. Prior to installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.05 INSTALLATION

A. Install woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.

B. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

C. Pressure Treated Wood: Handle, store, and install pressure treated wood in compliance with recommendations of chemical treatment manufacturer including those for adhesives, where required for installation.

D. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fasteners heads are required, use find finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

E. Tops: Anchor securely to base units and other support systems as indicated.

F. Finish hardware shall be installed without injuring other work and so that hardware works exactly as intended.

3.06 ADJUSTMENT, CLEANING, FINISHING, AND PROTECTION

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually where not possible to repair replace woodwork. Adjust joinery for uniform appearance.

B. Clean woodwork on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.

C. Complete the finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation of woodwork.

D. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures architectural woodwork being without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 07 16 00

CEMENTITIOUS WATERPROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including general and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Prepare surfaces to receive waterproofing.
B. Apply cementitious waterproofing from grade to minimum 8’ – 0” above grade at elevator shaft and elevator vestibule.

1.03 RELATED SECTIONS

A. Section 04 22 00: Concrete Unit Masonry
B. Section 07 62 00: Flashing and Sheet Metal

1.04 SUBMITTALS

Submit manufacturer's product data and instructions for application under provisions of Section 01 33 00.

1.05 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s absolute limits
    1. Do not apply cementitious waterproofing to unprotected surfaces in we weather or to surfaces on which ice, frost or water is visible.
    2. Do not apply cementitious waterproofing in rain, snow, fog, or mist.
B. Protection: Protect cementitious waterproofing to prevent damage from active rain for a minimum period of 24 hours from time of application.

1.06 MOCKUPS

A. Contractor shall provide 2’ x 2’ mock up of cementitious waterproofing applied to CMU.

    1. Construct the panel using CMU, mortar, reinforcing, tooling and cleaning as specified.
    2. Finish of cementitious waterproofing shall be smooth with minimal brush marks and then painted as called out in the elevator vestibule.
    3. The approved sample shall be the standard of workmanship
    4. Panel shall not be removed until cementitious waterproofing work as required by this

section has been accept or as directed by the Architect.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Product specified is KOSTER NB1 Grey, manufactured by KOSTER Bauchemie AG, Aurich, Germany. Bonding Agent specified is KOSTER SB Bonding Emulsion and primer specified KOSTER Polysil TG 500. The waterproofing system shall be a cement-based mix containing chemicals which penetrate with moisture into the capillary tracts and activate to form crystals which close the capillaries to produce the waterproofing effect. The cementitious waterproofing system shall become a permanent, integral part of the structure and shall be non-toxic, inorganic, free of calcium chloride and sodium-based compounds.

B. Substitutions: Under provisions of Section 01 60 00.

2.02 SYSTEM – NON-ACTIVE LEAKS

A. Waterproofing: Cementitious, crystallizing cement-based mix containing chemicals which penetrate with moisture into the capillary tracts and activate to form crystals which close the capillaries to produce a cementitious waterproofing system that becomes a permanent, integral part of the structure and is non-toxic, inorganic and free of added chlorides ad added sodium-based compounds.

1. Product: KOSTER NB1 Grey
    a. Approved for use in drinking water environments in compliance with NSD / ANSI 61

2. Physical Properties:
    a. Positive side Waterproofing: No signs of leakage, softening or discoloration up to 13.8 bar (200psi) / (140.5 m) of water head.
    b. Negative Side Waterproofing: no sign of leakage up to 13.8 bar (200psi) / (140.5 m) of water head.
    c. Compressive strength (ASTM C109, 28 days): 3,330 psi average
    d. Abrasion Resistance (ASTM D 4060, 28 days): 2.7 x 10 gram per cycle/47 cycles per mil.
    e. Compressive strength (EN12190, 28 days): >35 N/mm2
    f. Flexural tensile strength (28 days): >10 N / mm2

g. Adhesive tensile strength: > 1.5 N / mm2

h. Coefficient of water vapor diffusion resistance (μ): 60

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean surfaces thoroughly prior to installation. All concrete surfaces must be solid, sound, and free of all laitance, oils, grease, curing agents, or other foreign materials.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Clean surfaces to receive cementitious waterproofing, chip or abrasive blast to a CSP-3 (ICRI Guideline 3102R13) profile to remove defective materials and foreign matter such as paint, dirt, grease, curing agents, form release agents, and mineral salts.

D. If concrete surface has been previously treated with other agents, notify manufacturer before proceeding.

E. Repair cracks, expansion joints, control joints, and open surface honeycombs.
   a. Use KOSTER SB Bonding Emulsion with manufacturer approved concrete repair materials. (Such as the KOSTER Water Stop or KOSTER Repair Mortar). Comply with requirements listed in manufacturer's technical data information. No exceptions.
   b. Moving joints and cracks are treated and detailed as expansion joints. Install an elastic sealant and corresponding primer in accordance with sealant manufacturer's instructions.

F. Honeycombed areas, cavities, recesses and chipped out areas where form ties have been cut or removed must be routed/bush hammered to sound base and repaired according to manufacturer's instructions and patched flush with Repair Mortar.

G. Uneven brick or block work must be first rendered flush with Repair Mortar

H. Construction Joints: Construction joints should be thoroughly cleaned and dampened. Apply one slurry coat of KOSTER NB 1 Grey at the rate of 1.5 kg/m2. After it has reached an initial set, dampen if dry and apply a second coat of the KOSTER NB 1 Grey at the same rate. Pour concrete while the second coat is still less than 6 hours old to assist in bonding and to form an uninterrupted membrane.

I. Piping Preparation: Cut back around pipes at least 2.5 cm to give sufficient depth and clean thoroughly. Apply KOSTER KB Flex 200. Flush up the cavity with KOSTER KB-Fix 5.

J. Fillets and coves between Horizontal and Vertical Areas: Where fillets or coves are specified it is desirable that a cementitious waterproofing be applied behind the cove strip. Repair Mortar should be used.

3.02 APPLICATION

A. Install in accordance with manufacturer's instructions.

B. For areas with active leaks, provide active leak materials and installation per manufacturer's requirements before apply non-active leak system.

C. Mixing
1. For positive applications prepare a mixing liquid of at least 1 part KOSTER SB Bonding Emulsion to 7 parts clean water in a separate container. Mix the liquid with the NB1 Grey to a thick slurry consistency.
2. For negative side applications prepare a mixing liquid of at least one-part KOSTER SB Bonding Emulsion with 3 parts water. Mix the liquid with the KOSTER NB 1 Grey to a thick slurry consistency.
3. In hot weather where temperatures exceed + 30 C or when dry winds prevail, prepare a mixing liquid of at least 1 part KOSTER SB Bonding Emulsion to 3 parts water for the mixing liquid. Mix the liquid with the KOSTER NB 1 Grey to a thick slurry consistency.

D. Application – General:
1. Moisture must be present in the surface is necessary to begin the crystallization process.
2. Wet the dry surfaces thoroughly with clean water immediately prior to applying the slurry, making sure that no running or ponding water is present at time of application.
3. Apply the slurry with a cement brush in two coats. Work in such a way as to leave no areas void and no pin holes.

E. Application – Brush
1. Apply the KOSTER NB 1 Grey at a rate of min. 1.5 kg/m2 per coat. Brush application on surfaces other than formed concrete (positive side) is a minimum of 3 kg.m2 in two coats, allowing excess water to run off first.
2. Work in alternating coats from vertical to horizontal if brush applied on rough surfaces
3. Allow the first coat to dry to the touch with no transfer of material or apply the second coat when first coat will not mechanically damaged through the installation of the second. Wet the first coat with water prior to application of second coat, allowing excess water to run off first.
4. The KOSTER NB 1 Grey is self-curing. Do not apply any additional curing methods. Do no cover for 12 hours.
5. Finish to have minimal brush strokes in areas that are visible to the public.

3.03 PROTECTION

A. Protect cementitious waterproofing from contact with acid (below pH 7) and sulfates in concentrations exceeding limits for Portland Cement Type I/II.

B. Touch-up, repair or replace damaged products before Substantial Completion

C. Do not apply the cementitious waterproofing at temperatures below + 5 ºC.

D. Do not use curing compounds or water to bring mixture back to brushable consistency.

E. The treated area must be kept clear for at least 48 hours before backfilling or applying any concrete screed or other topping.

F. Unless broadcast and trowel application is used, the cementitious waterproofing is not designed to be a wearing surface. When waterproofing a horizontal surface that will be a subjected to traffic the area must be covered by concrete, cement, tile or other protective screed after 48 hours.

G. Cured KOSTER NB 1 coating may be painted. Do not use lime-based paints. Any paint used must be breathable. REF: Drawings.

H. Protect the treated area from temperatures below + 5 ºC during application and for 24 hours after application.

I. Use potable water for mixing and cleaning.

J. All salt burdened substrates must be primed with KÖSTER Polysil TG 500.

END OF SECTION

SECTION 07 17 00
WATERPROOFING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including general and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Prepare surfaces to receive waterproofing.

B. Apply waterproofing at below grade wall locations including elevator pit.

C. Seal joints and protrusions through dampproofing.

1.03 RELATED SECTIONS

A. Section 04 22 00: Concrete Unit Masonry

B. Section 07 62 00: Flashing and Sheet Metal

1.05 SUBMITTALS

Submit manufacturer's product data and instructions for application under provisions of Section 01 33 00.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Installing company should have at least three (3) years' experience in work of type required by this section, who can comply with manufacturer's warranty requirements, and who is an Approved Applicator as determined by waterproofing system manufacturer.

1.06 STORAGE AND HANDLING

A. Deliver materials in factory sealed and labeled packaging. Handle and store following manufacturer's instructions, recommendations, and material safety data sheets. Protect from construction operation related damage, as well as damage from weather, excessive temperatures and prolonged sunlight. Remove damaged material from site and dispose of it in accordance with applicable regulations.

B. Storage: Do not double-stack pallets during shipping or storage. Protect waterproofing materials from moisture, excessive temperatures, and sources of ignition. Provide cover, top and all sides for materials stored on site, allowing for adequate ventilation.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Product specified is CETCO Voltex, a Bentonite Geotextile Waterproofing Membrane: High-swelling and self-sealing sodium bentonite waterproofing to form a monolithic, low permeable membrane to protect the structure from water ingress. Include all mastic and adhesive necessary for a complete waterproof installation

B. Substitutions: Under provisions of Section 01 60 00.

PART 3 – EXECUTION

3.01 PREPARATION

A. Remove dirt, debris, oil, grease, cement laitance, or other foreign matter which will impair or negatively affect the performance of the waterproofing and drainage system.

B. Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing products during installation operations.

3.02 APPLICATION

A. Apply in accordance with manufacturer's instructions. Install Voltex membrane (white geotextile side down; dark gray geotextile side up) extending to interior edge of footing/slab edge, fully overlapping the 12” horizontal tail of the Voltex slab edge sheet installed in Section 3.04B. Overlap edges of adjacent Voltex sheets a minimum 4” and secure to prevent sheet movement during construction or concrete placement.

B. Place Voltex directly on properly prepared substrate (white geotextile side down; dark gray geotextile side up facing installer) with adjoining edges overlapped a minimum of 4”. Stagger sheet end seams a minimum of 24”. Mechanically fasten or staple Voltex as required to prevent movement from construction operations or concrete placement. When the slabs is poured in sections, extend Voltex a minimum 12” beyond the slab edge to enable proper overlapping.

C. Install waterproofing system at all grade beams, pole caps, elevator pit and other detail areas in accordance with manufacturer’s detail for specific project condition(s).

D. Slab Penetrations: For all pipe, rebar, structural or other penetrations install waterproofing system in accordance with manufacturer’s standard detail for specific project condition(s).

E. Inspect finished Voltex installation and repair any damaged material prior to concrete slab placement.

END OF SECTION

SECTION 07 19 00
WATER REPELLENT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to the work of this section.

1.02 WORK INCLUDED

A. Preparation, materials, services, and equipment required in conjunction with the application of a clear water repellent on all above-grade, vertical and horizontal, exterior exposed surfaces, including stone and concrete, masonry, cast stone, concrete, stucco, Confirm compatibility with masonry manufacturer prior to application.

1.03 RELATED SECTIONS

A. Section 04 05 00 – Mortar and Grout
B. Section 04 22 00 – Concrete Masonry Units

1.04 REFERENCES

FS SS-W-110 Federal Specification for Water Repellent, Colorless Silicone, Resin Base.

1.05 SUBMITTALS

A. Submit under the provisions of Section 01 33 00.

B. Product Specification Data: Submit manufacturer's technical literature, specifications, and application instructions for the specified clear water repellent material.

C. Samples: Obtain samples of water repellent for sample application. Sample application is covered in Section 1.06 QUALITY ASSURANCE.

D. Applicator Qualifications: Submit certification stating applicator has a minimum of three (3) years' experience using the specified product. Provide a list of several most recently completed projects where the specified material was used. Include the project name, location, architect and method of application.

E. Environmental Regulations: Submit certification stating the water repellent material to be applied is in compliance with federal, state, and local environmental Volatile Organic Compounds (VOC) regulations.

1.06 QUALITY ASSURANCE

A. Manufacturer: A firm with no less than ten (10) years experience in manufacturing the products specified in this section.

B. Applicator Qualification: A firm with no less than three (3) years' experience in the application of the products specified in this section. In addition, applicator must state the intended use of the proper application equipment and that it has been well maintained.

C. Mock-Up:

1. Apply water repellent per manufacturer's application instructions as directed by the Architect to substrate material, which matches actual job conditions. Determine the acceptability of appearance and optimum coverage rate required for application.

2. After sample treatment has cured in accordance with manufacturer's recommendations, water test to verify that substrate is coated with sufficient water repellent to effectively repel liquid water from the surface.
3. Obtain Architect and/or project Owner approval prior to full scale application of water repellents.

D. Pre-application Meeting: Convene a pre-application meeting prior to the start of application of the specified material. Attendance by a representative of each of the following organizations is requested; the application firm, the architectural firm, and the water repellent manufacturer. Notify each of the attendees at least three (3) days prior to the meeting time.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling: Store containers upright in a cool, dry, well ventilated place, out of the sun. Store away from all other chemicals and potential sources of contamination. Keep lights, fire, sparks, and heat away from containers. Do not drop containers or slide across sharp objects. Keep containers tightly closed when not in use. Store and handle materials in accordance with manufacturers written instructions.

1.08 PROJECT CONDITIONS

A. Surface Preparation: Surface must be free of cracks, dirt, oils, paint or other contaminants that may affect the appearance or performance of the water repellent material.

B. Project Environmental Requirements

1. Do not apply products under conditions outside manufacturer's requirements, which include:
   a. Surfaces that are frozen; allow complete thawing prior to installation.
   b. Surface and air temperatures below 40 degrees F.
   c. Surface and air temperatures above 95 degrees F.
   d. When surface or air temperature is not expected to remain above 40 degrees F for at least 8 hours after application.
   e. Wind conditions that may blow materials onto surfaces not intended to be treated.
   f. Less than 48 hours after a rain or 12 hours before rain is expected after installation.

2. Ventilate spaces receiving product in accordance with material manufacturers' instructions.

C. Protection:

1. Special precautions should be taken to avoid vapor transmission (fumes) from entering the building being treated. Ventilation systems and fresh air intakes should be turned off and closed.

2. Protect shrubs, metal wood trim, glass, asphalt and other building hardware during application from overspray.

3. Do not permit spray mist or liquid to drift onto surrounding properties.

1.09 WARRANTY

A. The contractor and applicator shall jointly and severally warrant water repellent material against failure in material and workmanship for a period of five (5) years from the date of application.

B. Submit completed manufacturers written “Request for Warranty Form” to manufacturer ten (10) days prior to application.

D. After substantial completion of the project, submit manufacturers written “5-Year Warranty Application” to manufacturer for processing. Upon receiving validated warranty, submit copies to Architect and building owner.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements indicated herein, provide products of one of the listed manufacturers.

1. PROSOCO, Inc., 3741 Greenway Circle, Lawrence, KS; (800) 255-4255; www.prosoco.com

2. Products in conformance with this specification by Grace or manufacturers approved by Architect.
3. Substitutions: Under provisions of Section 01 60 00 - Product Substitution Procedures.

2.02 MATERIALS – WATER REPELLENTS

Substrate	Type	Water Repellent
Brick / concrete	Clay/ concrete	Weather Seal Siloxane PD
CMU	Split Face and burnished or smooth face	Weather Seal Blok-Guard & Graffiti Control
	Interior Burnished/Ground Face	Sure Klean® Burnished Block Sealer

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify the following:

1. The required joint sealants have been installed.

2. Surface to be treated is clean, dry and contains no frozen water.

3. Environmental conditions are appropriate for application.

B. Verify that surfaces to receive water repellent are acceptable prior to application.

3.02 PREPARATION

A. Surface Preparation

1. Protect surrounding areas, landscaping, building occupants, pedestrians, vehicles, and non-masonry surfaces during the work from contact with masonry cleaners, residues, rinse water, fumes, wastes, and cleaning effluents in accordance with manufacturer's written instructions.
2. On surfaces to be coated or treated, remove dirt, dust, oil, grease, and other contaminants that would interfere with penetration or performance of products; where cleaners are required, use products recommended by manufacturer; rinse thoroughly and allow to dry completely.
3. Apply all specified sealants and caulking and allow curing before sealing process begins.
4. Divert and protect pedestrian and auto traffic.
5. Avoid wind drifting of spray of cleaning products, residues, and rinse water.
6. Protect open joints.

7. Work on this project includes cleaning existing concrete sign with Prosoco 2010 All surface cleaner in accordance with manufactures instructions then upon approval of architect and manufacture, and after staining / painting the letters and numbers sealing with Siloxane PD

3.03 APPLICATION

A. Seal in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.

B. Mix materials in strict accordance with manufacturer's instructions; do not dilute unless permitted by manufacturer.

C. Prevent overspray, wind drift, and splash onto surfaces not to be treated.

D. Material must be applied using low pressure application equipment designed for water repellent application.

E. Apply material as shipped by the manufacturer. Do not dilute.

F. Apply treatment evenly until surface is totally saturated. Coverage rates are dependent on substrate material. Only one saturation coat is required.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide the services of a manufacturer's authorized field representative **during application**, to verify specified products are used, and protection, surface preparation, and application of water repellents are in accordance with the manufacturer's written instructions and the test panel results approved by the Architect. Submit written field report from manufacturer's representative to Architect within 24 hours.

B. After water repellent has cured for 24 hours at low humidity and temperature between 70 and 90 degrees F or 48 hours at high humidity and low temperature between 50 and 69 degrees F, all surfaces shall be tested with a water spray. Re-coat any area that indicates water absorption.

3.05 CLEANING

A. At completion of work, remove protective coverings.

B. Protect completed work from damage during construction.

C. Clean site of all unused cleaning products, residues, rinse water, wastes, and cleaning effluents in accordance with environmental regulations.

D. Repair, restore, or replace to the satisfaction of the Architect, all materials, landscaping, and non-masonry surfaces damaged by exposure to the cleaning process.

END OF SECTION

SECTION 07 21 00
INSULATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Rigid insulation

B. Sound attenuation Batts.

C. Underslab insulation

1.03 RELATED WORK

A. Section 05 40 00 Cold Formed Metal Framing

B. Section 07 52 00 Modified Bitumen Roof

1.04 REFERENCES

A. ASTM C665 – Insulation blankets.

B. ASTM E84 – Surface Burning Characteristics of Building Materials.

1.05 SUBMITTALS

Submit manufacturer's product data and installation instructions per General Conditions.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. Products specified are manufactured by Owens/Corning Fiberglass, R Max, DOW Chemical and United States Gypsum, Johns Manville, Demilec (USA) LLC, and are listed as a standard of quality.

B. Products of Manville, Certainteed, Fibrex, U.G. Industries, Inc., Icynene, and Amoco Foam Products Co., conforming to specification requirements are acceptable.

C. Substitutions: Per General Conditions.

2.02 MATERIALS

A. Sound attenuation Batt insulation: Type: Owens Corning Fiberglass Unfaced glass fiber acoustical batt insulation complying with ASTM C 665, Type I. Thickness as indicated in the Documents.

B. Flame Spread: Shall be 25 or less in accordance with ASTM E84.

C. Rigid Insulation: Glass-fiber-reinforced enhanced closed cell polyisocyanurate foam core sheathing insulation panels with square edges Equal to RMax ECOMAXci FR Air Barrier with 12 mil facer (1.5 mil aluminum facer and 10.5 mil fiberglass reinforcement) or DOW Dupont "THERMAX, XARMOR™ ci Exterior Insulation" with a 4-mil front facer and 1.25 mil embossed aluminum back facer. Product shall be 1.0" with a min. R6.5 value at exterior walls applied per manufacturer's instructions including sealing all seams, joints, and openings with manufacture's recommended liquid flashing product (unless otherwise specified in the specifications) to meet the ci requirements per 2015 IECC. Product shall meet ASTM C518, and have a six-month exposure capacity to outdoor elements and 15-year thermal warranty. Code compliance: Class A (<= 25 Flame Spread Index and < 450 Smoke Developed Index) for both core AND finished product classified at max thickness per UL 723 criteria or ASTM E84 criteria. Fire propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly. (Also refer to Roof Specifications for roof insulation for additional rigid insulation requirements).

Fasteners: Provide polymer or other corrosion protective coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness. Product shall be as listed below or applicable for this project as recommended and designed by insulated sheathing manufacturer and approved by architect.

a. Acceptable Products:
   1) Trufast (formerly Rodenhouse). 2" diameter "Thermal-Grip" CI prong washer with "Grip-Deck" ceramic- coated, self-drilling screw.
   2) Use the Grip-Lok auto-feed fastening system for high-speed application (recommended for wall assemblies up to 2 inches in thickness. Contact Trufast (formerly Rodenhouse Inc.) for more information at 616-454- 3100.
   3) To secure ci Exterior Insulation to CMU walls use mechanical fasteners with thermal break as recommended by manufacture. Care shall be taken to avoid damage to the insulation.

E. Underslab Rigid Insulation: 1.5 " (min R9.6) thermal insulation board composed of a closed-cell polyisocyanurate (polyiso) foam core bonded to glass fiber reinforced aluminum facers on both sides equal to Rmax TSX-8510. The exposed side of the board shall have a white modified acrylic coating to provide an attractive reflective finish. Product shall comply with Class A flame spread and smoke developed indices and shall be tested per UL1715/NFPA 286 to comply with IBC Section 2603. Install with manufacture's recommended fasteners for securing to concrete and as recommended for this location, exposure, and wind conditions. Joint seams to be filled and sealed to manufacturer recommendations. Miter corners and provide white foil tape along all edges/corners. Provide minimum 4'x8' mockup that includes the beam condition, for Architect's approval prior to proceeding. Dupont Thermax Heavy duty insulation (glass fiber reinforced with thermoset coated aluminum facer) installed with similar attachment as

approved by manufacture is acceptable)

PART 3 – EXECUTION

3.01 INSTALLATION

1. Installation shall be in accordance with the manufacturer's printed instructions for the specific product.
2. Installation shall not be made until the building has been made substantially water and weathertight, until mechanical and electrical trades have installed, tested, and have had their covered-in-work approved.
3. Install insulation tightly fitted together. Seal all joints in rigid insulation to create a thermal and vapor barrier. Seal joints around pipes or electrical outlets penetrating the insulation. Use manufacture's recommended closure system at all joints and penetrations. Notify architect when complete before covering up work for observation of all joints and penetrations.
4. Work compressed, displaced, or otherwise injured through lack of prompt enclosure shall be removed and replaced with new undamaged material.
5. Batt Insulation and spray insulation, where installed, shall entirely fill all voids, spaces, holes and cracks to the depths and widths as indicated on the drawings or specified.
6. In general, continuity of insulation shall be maintained. Use full length sheets where possible.
7. Upon completion, and at times when other contractors are covering work, correct any loose, sagged, compressed, or otherwise damaged work, and ensure that all work covered is in proper condition.
8. Provide 8" sound attenuation batts above ceilings as indicated in Documents. Insulation shall be uninterrupted above rooms indicated and extended for 4' in each direction beyond perimeter walls or extend vertically to roof deck and seal walls where perimeter wall extends to deck.
9. Install Foamed-in-place-insulation at voids within perimeter CMU walls, per maufacturer's recommendations. Include in masonry mockup. Patch damaged areas.
10. Allow architect to observe complete insulation prior to covering (both rigid and batt insulation).

END OF SECTION

SECTION 07 27 00
FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 – GENERAL

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.01 SECTION INCLUDES

A. Materials and installation for fluid-applied membrane to provide an air barrier component and secondary waterproof barrier/drainage plane to be used continuously at all cavity walls behind the veneer, over exterior sheathing and for all wall assemblies and underside of insulated slabs / floors where insulation is indicated.

1.02 RELATED DOCUMENTS

1. The Contract Documents as defined in Section 01 11 00 – Summary of Work, apply to the Work of this Section.

1.03 RELATED SECTIONS

A. Section 04 05 23 – Wall Flashing

B. Section 07 21 00 – Insulation

C. Section 07 62 00 – Metal Flashing and Trim

D. Section 07 92 00 – Caulking and Sealant

E. Section 09 20 00 – Gypsum Wallboard, Metal Frame System

1.04 REFERENCED DOCUMENTS

A. ASTM Standards

1. C 79 - Specification for Gypsum Sheathing Board
2. C 297 - Test Method for Tensile Strength of Flat Sandwich Constructions in Flatwise Plane
3. C 1177 - Specification for Glass Mat Gypsum Substrate for Use as Sheathing
4. D 522 - Test Methods for Mandrel Bend Test of Attached Organic Coatings
5. D 882 - Test Methods for Tensile Properties of Thin Plastic Sheeting
6. D 2247 - Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
7. D 3273 - Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
8. E 84Test Method for Surface Burning Characteristics of Building Materials
9. E 96 - Test Methods for Water Vapor Transmission of Materials
10. E 283 - Test Method for Determining the Rate of Air Leakage Through Exterior

11. Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
12. E 330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
13. E 331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
14. E 1233 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

B. Building Code Standards

1. SBCCI PST & ESI Evaluation Guide on Floor, Wall, and Roof Systems (Testing for Moisture Protection Barriers), Evaluation Guide 119.
2. UBC 26-9, Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus
3. ICBO Acceptance Criteria for Exterior Insulation and Finish Systems, AC 24
4. CCMC Technical Guide on Air Barriers

C. Gypsum Association

1. GA-600 Fire Resistance Design Manual
2. GA-253 Recommended Specifications for the Application of Gypsum Sheathing
3. GA-254 Fire-Resistant Gypsum Sheathing

D. American Plywood Association

1. E30 Residential and Commercial Construction Guide

E. Proprietary Specifications

1. 102250 Georgia-Pacific Corporation, “Dens Glass® Gold Sheathing”
2. AATCC (American Association of Textile Chemists and Colorists), Test Method127, Water Resistance: Hydrostatic Pressure Test

F. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

1. 2001 ASHRAE Handbook--Fundamentals

1.05 DESIGN REQUIREMENTS

A. Deflection Criteria: Maximum allowable deflection normal to the plane of the wall: L/240

B. Wind Load: Conform with code requirements.

C. Air Barrier Continuity: provide continuous air barrier system of compatible air barrier components.

D. Mechanical Ventilation: maintain pressurization and indoor humidity levels in accordance with recommendations of ASHRAE (see 2001 ASHRAE Handbook—Fundamentals).

1. Minimize condensation within the assembly.
2. Drain water to the exterior, away from components in the wall assembly (windows and doors, for example).
3. Provide flashing to direct water to the exterior in accordance with code requirements, including, above window and door heads, beneath window and door sills, at roof/wall intersections, decks, intersections of lower walls with higher walls, and at the base of the wall.

1.06 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittals.

B. Product Data: Submit manufacturer's product data sheets on all products to be used for the work. Submit description for protection, surface preparation, application, and clean-up.

C. Applicator Qualifications: Submit qualifications of applicator.

D. Samples for approval as directed by architect or owner.

E. Prepare and submit project-specific details.

1.07 QUALITY ASSURANCE

A. Manufacturer requirements:

Manufacturer of masonry treatments for a minimum of 25 years in North America.

B. Contractor requirements:

Knowledgeable in the proper use and handling of specified products.
Employ skilled mechanics who are experienced and knowledgeable in air and moisture barrier application, and familiar with the requirements of the specified work.
Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with manufacturer's published specifications.

C. Prior to installation, apply air/moisture barrier system as follows to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution:

1. Construct typical exterior wall panel, 8 feet long by 8 feet wide, incorporating back-up wall, cladding, window and doorframe and sill, insulation, flashing, etc., illustrating materials interface and seats.
2. Install air/moisture barrier mock-ups in field constructed mock-ups of unit masonry assemblies illustrating materials interface and seals. Use the manufacturer’s application instructions.
3. Keep mock-ups available for inspection throughout the project.

D. Pre-Application Meeting: Convene a pre-application meeting prior to the start of installation of fluid-applied membrane air barrier. Require attendance of parties directly affecting work of this section, including the Contractor, Architect, applicator, and manufacturer representative. Review environmental regulations, mock-up procedures, protection of surrounding areas and non-masonry surfaces, surface preparation, application, field quality control, final cleaning, and coordination with other work.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in their original sealed containers bearing manufacturer's name and identification of product.

B. Protect coatings (pail products) from freezing temperatures and temperatures in excess of 90° F (32° C). Store away from direct sunlight.

1.09 PROJECT/SITE CONDITIONS

A. Maintain ambient and surface temperatures above 40° F (4° C) during application and drying period, minimum 24 hours after application of air and moisture barrier.

B. Provide supplementary heat for installation in temperatures less than 40° F (4° C) or if surface temperature is likely to fall below 40° F (4° C). *(Note: surface temperature is lower than air temperature at night).*

C. Provide protection of surrounding areas and adjacent surfaces from application of materials.

1.10 COORDINATION/SCHEDULING

A. Coordinate installation of foundation waterproofing, roofing membrane, windows, doors and other wall penetrations to provide a continuous air barrier.

B. Provide protection of rough openings before installing windows, doors, and other penetrations through the wall.

C. Provide sill flashing to direct water to the exterior before windows and doors are installed.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Products specified are manufactured by PROSOCO, Inc., 3741 Greenway Circle, Lawrence, KS 66046, (800) 255-4255, (785) 865-4200 and are listed as a standard of quality.

Product Description

PROSOCO R-GUARD™ is a fluid applied air and moisture barrier that stops air and water leakage through cavity wall, masonry veneer construction. The system consists of R-GUARD™ Joint & Seam Filler, R-GUARD™ FastFlash and R-GUARD™ Cat 5.

B. Substitutions under provisions of General Conditions and shall be approved by Architect prior to Pre bid meeting.

2.02 AIR AND MOISTURE BARRIER

PROSOCO R-GUARD™ Cat 5: Fluid applied, air and water-resistive barrier membrane that combines silicone and polyurethane properties. Single component, Silyl-Terminated-Polymer (STP) that is spray or roller applied to produce a highly durable, seamless, elastomeric weatherproofing membrane on exterior building envelope substrates, in addition to behind open-jointed or vented rain screen cladding. Prevents water and air penetration of the building envelope in weather up to 155 mph winds of a Category 5 hurricane.

2.03 FLASHING TRANSITIONS

PROSOCO R-GUARD™ Joint and Seam Filler: high modulus, gun-grade, crack and joint filler for use with PROSOCO R-GUARD™ FastFlash, a gun-grade waterproofing, adhesive and detailing compound, to reinforce rough openings, inside and outside corners and sheathing points. These single-component, Silyl-Terminated-Polymer (STP) products prepare open joints, seams, cracks, and rough openings to prevent the movement of water and air through building envelopes.

2.04 WATER BASED PRIMER FOR RAW GYPSUM BOARD EDGES

PROSOCO R-Guard PorousPrep: primer to seal the cut edges of gypsum wall boards where they are exposed in rough openings for windows and doors. The sealed edge makes a compatible surface for easy application of liquid applied fiber-reinforced fill coat and seam treatment for through-wall components.

2.05 INTERIOR SEALANT FOR WINDOWS AND DOORS

PROSOCO R-Guard AirDam: high performance, gun-grade waterproofing sealant that combines the silicone and polyurethane properties. Single component, Silyl-Terminated-Polymer (STP) that is that is durable and stops the movement of moist air through cracks surrounding windows and doors.

2.06 PREFORMED SILICONE SEALANT EXTRUSION

PROSOCO R-Guard SureSpan EX: manufacturer's standard system consisting of pre-cured low modulus elastomeric extrusion that provides a continuous transition and bridges [windows and doors frames at curtain wall] [storefront] [expansion joints] [skylights] [roof] to air barrier materials. Provide continuous Preformed Silicone Sealant Extrusion System that is flexible, durable, designed for high dynamic and thermal movement which is resistant to ultraviolet exposure and weathering.

2.07 EQUIPMENT

A. Rust-free electric drill and paddle for mixing R-GUARD™ Cat 5 to a uniform consistency.

B. Standard ¼ inch to 3/8 inch nap rollers for applying R-GUARD™ Cat 5.

C. Dry knife, trowel or spatula to tool and spread the R-GUARD™ Joint and Seam Filler and R-GUARD™ FastFlash.

2.05 MIXING

A. Mix materials with a clean, rust-free electric drill and paddle.

B. Do not dilute materials with water or add other ingredients.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Inspect sheathing application for compliance with applicable requirement:

1. Exterior gypsum sheathing — GA-253
2. Exterior Grade and Exposure I wood based sheathing — APA E30
3. Glass mat faced gypsum sheathing — Georgia Pacific Publication 102250
4. Cementitious sheathing — Consult manufacturer's published recommendations
5. Continuous Insulation — Consult manufacturer's published recommendations

B. Report deviations from the requirements of project specifications or other conditions that might adversely affect the air and moisture barrier installation. Do not start work until deviations are corrected.

3.02 SURFACE PREPARATION

A. Remove surface contaminants and replace damaged sheathing.

B. Spot surface defects in sheathing with R-GUARD™ Joint and Seam Filler.

C. Repair cracks, spalls, or other damage in concrete or concrete masonry surfaces

D. Seal the cut edges of gypsum wall boards exposed to rough openings for windows and doors at corners.

3.03 INSTALLATION

A. Apply R-GUARD™ Joint and Seam Filler for seams, joints, cracks, gaps, primed rough gypsum edges at sheathing, rough openings:

a. Fill or repair cracks up to 3/8 inch with R-Guard™ Joint & Seam Filler.
b. Treat cracks ranging from 3/8 inch to 1 inch with backer rod before applying R-Guard™ Joint & Seam Filler.

c. Cracks larger than 1 inch must be structurally improved or addressed with R-Guard SureSpan EX.
d. Fill surface defects and over driven fasteners with R-GUARD™ Joint & Seam Filler.
e. Using a dry knife, trowel or spatula, tool and spread the product. Spread one inch beyond seam at each side to manufacturer's recommended thickness.
f. Allow to skin before installing other waterproofing or air barrier components.
g. Apply in accordance with manufacturer's Application Guideline illustrations.

B. Apply R-GUARD™ FastFlash over surfaces prepared with R-GUARD™ Joint & Seam Filler to seal and waterproof rough openings:

a. Apply a thick bead of R-GUARD™ FastFlash over any visible gaps in the prepared rough opening.
b. Immediately press and spread the wet product into gaps.
c. Allow treated surface to skin.
d. Starting at the top, apply a thick bead of R-GUARD™ FastFlash in a zigzag pattern to the structural wall surrounding the rough opening.
e. Spread the wet product to create an opaque, monolithic flashing membrane which surrounds the rough opening and extends 4 to 6 inches over the face of the structural wall. Apply and spread additional product as needed to create an opaque, monolithic flashing membrane free of voids and pin holes.
f. Apply additional product in a zigzag pattern over a structural framing inside the rough opening.
g. Apply R-GUARD™ FastFlash within temperature and weather limitations as required by manufacturer.
h. Apply R-GUARD™ FastFlash to perimeters, sills and adjacent sheathing and building face, in accordance with manufacturer's product data and installation instructions.
i. At sills, extend flexible flashing on building face a minimum of 4 to 6 inches beyond and 3 inches above sill-jamb intersection.
j. Apply interior sealant for windows and doors installation per manufacturer's written instructions.
k. Install preparation products in accordance with manufacturer's Application Guideline illustrations.

C. Apply appropriate R-GUARD™ Cat 5 air and water-resistive barrier to clean, dry and/or damp substrates within temperature and weather limitations as required by manufacturer:

a. Seal masonry ties and other penetrations as work progresses.
b. Apply to recommended thickness. Proper thickness is achieved when coating is opaque.
c. Allow product to cure and dry.
d. Inspect membrane before covering. Repair any punctures, translucent or damaged areas by applying additional material.
e. Specifier Note: If air or surface temperature exceed 95 degrees Fahrenheit (35 degrees Celsius), apply to shaded surfaces and before daytime air and surface temperatures reach their peak.
f. Specifier Note: Overlapping repairs, penetration treatments, transitions, rigid flashing and other air barrier components ensures positive drainage and continuity of the air and water-resistive barrier.
g. On CMU wall construction apply back rolling may be necessary to achieve a pinhole free surface.

D. Apply R-GUARD™ Joint and Seam Filler and R GUARD™ FastFlash as a liquid flashing membrane to waterproof the transitions in rough opening and between dissimilar materials

a. Fill any voids between the top of the flashing leg and the vertical wall with R-GUARD™ Joint & Seam Filler. Tool to direct water from the vertical wall to the flashing.
b. Apply a generous bead of FastFlash to the top edge of the flashing leg.
c. Spread the wet products to create a monolithic “cap-flash” flashing membrane extending 2 inches up the vertical face of the structural wall and 1 inch over the flashing membrane extending. Apply additional product as needed to achieve a void and pinhole free surface. This “liquid termination bar” helps secure the flashing and ensures positive drainage from the wall surface to the flashing.
d. Allow treated surfaces to skin before installing other wall assembly, waterproofing or air barrier components.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide the services of a manufacturer's authorized field representative to verify specified products are used, and protection, surface preparation, and installation are in accordance with the manufacturer's written instructions and the mock-ups approved by the Architect. Submit manufacturer written reports of field visit to Architect prior to beginning masonry veneer installation or covering installation. If membrane is applied in different areas of the building or project at different times separated by more than one week there shall be separate manufacture reports for each application.

END OF SECTION

SECTION 07 52 16

MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. SBS-modified bituminous membrane roofing.

B. Cover board.

C. Roof insulation.

1.02 RELATED SECTIONS

A. Division 05 Section "Steel Decking" for steel roof deck..

B. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, cants, curbs, and blocking.

C. Division 07 Section "Sheet Metal Flashing and Trim" for flashings and counter flashings.

D. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.03 REFERENCES

A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms in this Section:

1. ASTM D 1079 “Standard Terminology Relating to Roofing and Waterproofing.”

2. Glossary of NRCA’s “The NRCA Roofing and Waterproofing Manual.”

3. Roof Consultants Institute “Glossary of Building Envelope Terms.”

4. International Building Code (IBC)

5. American Society of Civil Engineers (ASCE-7) Minimum Design Loads for Buildings & Other Structures

B. Sheet Metal Terminology and Techniques: SMACNA “Architectural Sheet Metal Manual.”

C. Hot Roofing Asphalt: Roofing asphalt heated to temperature recommended by roofing manufacturer to flux modified roofing membrane, measured at the mop cart or mechanical spreader immediately before application.

1.04 DESIGN CRITERIA

A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Installer shall comply with current code requirements based on authority having jurisdiction.

D. Wind Uplift Performance: Roofing system shall meet the intent of systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7 and as indicated on the Structural Notes.

1. **Field Prime Uplift Pressure:** **lbf/sq. ft.**

2. **Field-of-Roof Uplift Pressure:** **lbf/sq. ft.**

3. **Perimeter Uplift Pressure:** **lbf/sq. ft.**

4. **Corner Uplift Pressure:** **lbf/sq. ft.**

E. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; UL 790, for application and roof slopes indicated.

1.05 SUBMITTALS

A. Product Data: Manufacturer's data sheets for each product to be provided.

B. Detail Drawings: Provide roofing system details and details of attachment to other Work, including:

1. Base flashings and membrane terminations.

2. Tapered insulation, including slopes.

3. Crickets, saddles, and tapered edge strips, including slopes.

4. Insulation fastening and adhesive patterns.

C. Verification Samples: Provide for each product specified.

D. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturers product who is eligible to receive manufacturers special warranty.

E. The roofing system must be installed by an applicator authorized and approved by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of

having at least five (5) years successful experience installing modified bitumen roofing systems and having installed at least one (1) roofing application or several similar systems of equal or greater size within one year.

F. Provide a 3-year weathertightness warranty against all leaks.

G. Pro-rated Warranties shall not be accepted.

H. Guarantees: Provide manufacturer's current guarantee specimen.

I. Prior to roofing system installation, roofing sub-contractor shall provide a copy of the Guarantee Application Confirmation document issued by manufacturer indicating that the project has been reviewed for eligibility to receive the specified guarantee and registered.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product who is eligible to receive the specified manufacturer's guarantee.

B. Manufacturer Qualifications: Qualified domestic U.S. owned and based manufacturer that has UL listing or accredited testing agency for roofing system identical to that used for this Project.

C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.

D. Test Reports:

1. Roof drain and leader test or submit plumber's verification.

2. Core cut, if required.

3. Roof deck fastener pullout test, if required.

E. Source Limitations: Obtain all components from the single source roofing manufacturer guaranteeing the roofing system. All products used in the system shall be labeled by the single source roofing manufacturer issuing the guarantee.

F. Provide evidence of CERTA training for any installer of torch-applied modified bitumen membrane. Copies of certifications are required prior to award and shall be maintained on the jobsite for inspection at any time.

G. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the specifier. Any deviation from the manufacturer's installation procedures must be supported by written certification on manufacturer's letterhead and presented for the specifier's consideration.

H. Manufacturer shall provide a minimum of 3 roof inspections during installation of each roof and submit field report of each inspection. Inspection shall validate installation of roof in compliance with manufacturer's details and recommendations.

I. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine

whether or not corrective work will be required before the warranty will be issued. Notify the architect seventy-two (72) hours prior to the manufacturer's final inspection.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

E. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

1.08 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.09 EXISTING CONDITIONS

If discrepancies are discovered between the existing conditions and those noted on the drawings, immediately notify the owner's representative by phone and solicit the manufacturer's approval prior to commencing with the work. Necessary steps shall be taken to make the building watertight until the discrepancies are resolved.

1.10 WARRANTY

A. Provide manufacturer's system guarantee equal to Johns Manville's Peak Advantage No Dollar Limit Roofing System Guarantee.

1. Single-source special guarantee includes roofing plies, base flashings, liquid applied flashing, roofing membrane accessories, roofing membrane, roof insulation, fasteners, adhesives, cover board, walkway products, [manufacturer’s edge metal products, and other approved single-source components of roofing system marketed by the manufacturer.

2. Guarantee Period: 30 years from date of Substantial Completion.

3. Contractor is required to list **“QUORUM ARCHITECTS INC”** as the Specifier/Consultant of record in the appropriate fields (“Specifier Account”) when applying for the manufacturer’s warranty.

B. Installer's Guarantee: Submit roofing Installer's guarantee, signed by Installer, covering Work of this Section, including all components of roofing system, for the following guarantee period:

1. Guarantee Period: two years from date of Substantial Completion.

C. Existing Guarantees: Guarantees on existing building elements should not be affected by scope of work.

1. Installer is responsible for coordinating with building owner's representative to verify compliance.

PART 2 - PRODUCTS

2.01 GENERAL

A. Unless otherwise approved by the specifier and accepted by the membrane manufacturer, all products (including insulation, fasteners, fastening plates, adhesives and other accessories) must be supplied by the roofing system manufacturer.

B. Substitutions under provisions of Section 01 60 00.

2.02 MANUFACTURER

A. Products specified are manufactured by Johns Manville Roofing System are listed as a standard of quality.

1. Contact Robert Kadela (415) 200-6726

B. Products of U.S. Ply, Inc. – P.O. Box 11740, Ft. Worth, TX 76110, **conforming to these specifications,** are acceptable. No other substitutions will be considered.

2.03 BASE PLY AND CAP-SHEET MATERIALS

A. Roofing Membrane Sheet: SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

1. ASTM D 6163, Grade S, Type I, glass-fiber-reinforced, Basis of design: DynaWeld Base .

2. US Ply

B. Roofing Membrane Cap Sheet: SBS-modified asphalt sheet; granular surfaced; suitable for application method specified.

1. ASTM D 6163, Grade G, Type I, glass-fiber-reinforced, Basis of design: DynaWeld Cap FR CR G .

2. Highly reflective granular surface with minimum reflectivity (per ASTM C 1549): 0.72

3. US Ply

2.04 FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 4601, Type II, asphalt-impregnated and coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides. Basis of design: PermaPly 28

B. Backer Sheet: SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

1. ASTM D 6163, Grade S, Type I, glass-fiber-reinforced, Basis of design: DynaWeld Base.

C. Flashing Sheet: SBS-modified asphalt sheet; granular surfaced; suitable for application method specified.

1. ASTM D 6163, Grade G, Type I, glass-fiber-reinforced, Basis of design: DynaWeld Cap FR CR G.

D. Liquid Applied Flashing: A liquid and fabric reinforced flashing system created with a stitch bonded polyester scrim and a two-component, moisture cured, elastomeric, liquid applied flashing material, consisting of an asphalt extended urethane base material and an activator. Basis of design: PermaFlash System

2.05 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.

B. Asphalt Primer: ASTM D 41. Basis of design: JM Asphalt Primer

C. Asphalt Roofing Cement: ASTM D 4586, type I, asbestos free, of consistency required by roofing system manufacturer for application. Basis of design: MBR Utility Cement

D. Mastic Sealant: As required by Johns Manville.

E. Fasteners: Factory-coated steel fasteners and metal plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and provided by the roofing system manufacturer. Basis of design: All Purpose Fasteners and Plates

F. Roofing Granules: Ceramic-coated roofing granules matching specified cap sheet, provided by roofing system manufacturer. CR Roofing Granules

G. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

2.06 WALKWAYS

A. Walkway Pads: Mineral-granule-surfaced, reinforced modified asphalt composition, slip-resisting pads, manufactured as a traffic pad for foot traffic provided by roofing system manufacturer, with a pad size of 32-inch x 32-inch. Basis of design: DynaTred Walkway

2.07 COVER BOARD

A. Gypsum Board: ASTM C 1177, Heavy duty coated glass-mat facer with Eonic primed face,, water-resistant gypsum substrate for adhered roof applications 1/2 inch (13 mm) thick. Basis of design: Dens Deck Prime Roof Board

2.08 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), Basis of design: ENRGY 3

1. Provide insulation package with minimum R Value: R-25.2.

2. Provide insulation package with minimum thickness: 4.4

3. Provide insulation package in multiple layers.

4. Minimum Long-Term Thermal Resistance (LTTR): 5.7 per inch.
   a. Determined in accordance with CAN/ULC S770 at 75ºF (24ºC)

2.09 TAPERED INSULATION

A. Tapered Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), Basis of design: Tapered ENRGY 3

2.10 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Provide saddles, crickets, tapered edge strips, and other insulations shapes where indicated for sloping to drain. Fabricate to slopes indicated. Basis of design: Tapered Fesco Edge Strip.

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer. Basis of design All Purpose Fasteners and UltraFast Plate

D. Urethane Adhesive: Manufacturer’s two component polyurethane adhesive formulated to adhere insulation to substrate. Basis of design: JM Two-Part Urethane Insulation Adhesive (UIA)

E. Insulation Cant Strips: ASTM C 728, perlite insulation board. Basis of design: FesCant Plus

F. Wood Nailer Strips: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry."

2.11 EDGE METAL COMPONENTS

A. Shop-Fabricated Edge Metal: Custom-fabricated edge metal meeting the criterion of ANSI/SPRI ES-1. Must be approved by manufacturer technical representative. Minimum requirements:

1. Steel: 24 gauge minimum, fastened 6 inches on center.

2. Aluminum: 0.05 inch thick, fastened 6 inches on center.

B. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

C. Roof Edge Drainage Systems: Gutter Systems: Manufactured in section lengths not exceeding 12 feet with 0.100-inch mill aluminum internal Gutter Hangers, 24 inches on center, and 2-inch-wide formed external wind straps 6’-0” on center

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with the requirements affecting performance of roofing system.

1. General:

a. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
b. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

2. Steel Decks:

a. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."

3. Ensure general rigidity and proper slope for drainage.

4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units more than 1/16 inch (1.6 mm) out of plane relative to adjoining deck.

B. Unacceptable panels should be brought to the attention of the General Contractor and Project Owner’s Representative and shall be corrected prior to installation of roofing system.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General:

1. The minimum roof deck construction and deck surface preparation requirements which follow are provided as a supplementary guide for the roof deck designer and erector.

2. Acceptance of a roof deck by the manufacturer as satisfactory to receive roof materials only refers to the deck surface and slope.

3. Decks must be adequately smooth and level to provide support and maximum contact surface for roofing materials. The surface of the roof deck must be dry (free of moisture in any form), firm, smooth, clean, free of debris, sharp projections and depressions.

4. Remove electrical conduits, bolts, and other small items from the surface of the roof deck as these areas cannot be properly insulated and roofed.

5. All depressions, holes, deformations, etc. shall be made smooth prior to the roofing application.

6. All decks must be properly designed and constructed in accordance with the deck manufacturer's requirements and specifications, must be installed by applicators approved by deck manufacturer, must be able to support and secure the roof system, and must be properly related to the rest of the building.

7. Complete all openings or projections (all pipes, vents, ducts, stacks and openings, etc.) through the deck prior to roof system installation. No projections shall be constructed through the flashing cant and projections shall be located a minimum 18" (45.7 cm) from the intersection of the cant and roof deck.

8. Do not install electrical conduit or piping immediately above the roof deck. Roof systems cannot be properly installed and adhered around and/or over conduit.

9. All roof decks shall be designed and constructed:

    a. To support maximum loads which may be imposed during and after construction without excessive deflection (1/240 of the span at midspan is the rule for maximum allowable deflection);

    b. To provide a minimum ¼" (6 mm) per-foot slope and/or designed so that ponding water dissipates within a 48 hour period. Interior drains should be sumped below roof level to allow immediate water runoff.

    c. Provisions to prevent asphalt drippings must be given consideration where joints, cracks, or holes occur.

    d. On slopes 1/2inch per foot or greater, provisions must be made for insulation stops and/or back nailing of built-up felts. Insulation stops and/or backing nailing must be used on slopes greater than ½" (4 cm per meter) when SBS membranes are used;

e. with suitable expansion joints to accommodate structural expansion and contraction. Expansion joints must extend through the structural system to be acceptable, and must separate adjoining units, or additions.

f. Deck materials must be fastened to supporting members by clips, welding or other mechanical devices to prevent lateral and vertical movement of the elements;

g. To be consistent with applicable trade associations, as well as any code or insurance requirements.

B. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.

C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

D. If applicable, prime surface of deck with primer at a rate recommended by roofing manufacturer and allow primer to dry.

E. Proceed with each step of installation only after unsatisfactory conditions have been corrected.

F. Steel Deck:

1. Insulation boards of minimum thickness to span flutes as recommended by the insulation manufacturer are required over steel decks.

a. Wood nailers of equivalent thickness to the roof insulation must be provided at perimeters and projection openings to act as an insulation stop and to provide nail holding capability for the nailing flanges of metal flashing.

2. Rigid roof insulation boards and when applicable the base sheet must be uniformly secured to the steel deck with approved mechanical fasteners.

G. New Construction:

1. The deck shall be inspected, cleaned, repaired and otherwise conditioned to conform to the requirements of a new deck.

2. Prime all masonry, metal and existing asphalt surfaces and substates with USP™ #41 Standard Asphalt Primer where roofing materials are to be adhered.

3. Inspect all roof drains and outlets. Remove existing drain flashings and replace broken or stripped bolts, clamping rings. Plastic drains are not acceptable. All drains, including retrofit or insert drains, must be sumped to properly remove water from the roof surface and meet applicable code requirements.

4. All penetrations and expansion joints shall extend approximately 8” (20 cm) above the top of the finished roof surface.

3.03 INSULATION INSTALLATION

A. Coordinate installation of roof system components so insulation and cover board are not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Insulation must not be left exposed to the weather. No more insulation shall be applied that can be completely covered with the finished roof each day.

E. Do not kick insulation boards into place.

F. Install insulation boards with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer’s written instructions. Fill gaps exceeding 1/4 inch (6 mm) with like material.

G. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

H. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.

I. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

J. Adhered Insulation: Adhere insulation to substrate as follows: Taper system only.

1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer’s instruction.

2. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.

K. Loose Laid Insulation with Top Insulation Layer Mechanically Fastened: Loose lay insulation with staggered joints and secure top layer of insulation to deck using mechanical fasteners designed and sized for fastening specified board-type to deck type.

1. Fasten top layer to resist uplift pressure at corners, perimeter, and field of roof.

L. Mechanical Attachment to Steel Deck

1. Lay insulation with joints staggered in one direction to achieve FM 1-90 wind uplift resistance. Secure insulation into the steel deck at rate of 1 fastener per 2.67 sq. ft (12 per 4’ x 8’ board) or as required to achieve specified wind uplift whichever is more stringent.

2. For supplemental perimeter and corner enhancements of fastener density at perimeters, add 50% more fasteners, but not less than 1 per 2 SF. At corners, add 100% more fasteners, but not less than 1 per 1 SF.

3.04 COVER BOARD INSTALLATION

A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.

C. Install cover board with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4 inch (6 mm) with cover board.

1. Cut and fit cover board within 1/4 inch (6 mm) of nailers, projections, and penetrations.

D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.

1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

E. Adhered Cover Board: Adhere cover board to substrate as follows:

1. Install in a two-part urethane adhesive according to roofing system manufacturer's instruction.

2. Install to resist uplift pressure at corners, perimeter, and field of roof.

3.05 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.

B. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

C. Where roof slope exceeds 1/2 inch per 12 inches (1:24), contact the membrane manufacturer for installation instructions regarding installation direction and backnailing

D. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.

1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

3. Remove and discard temporary seals before beginning work on adjoining roofing.

E. Substrate-Joint Penetrations: Prevent roofing asphalt from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.06 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

A. Install modified bituminous roofing membrane sheet, and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, with the following installation method:

1. Unroll roofing membrane sheets and allow them to relax.

2. Heat weld modified bituminous roofing membrane base and cap sheet to substrate according to roofing system manufacturer’s instruction.

B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.

2. As required, apply roofing granules to cover exuded bead at laps while bead is hot.

C. Install roofing membrane sheets so side and end laps shed water.

3.07 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.

2. Backer Sheet Application: Mechanically fasten backer sheet to walls or parapets.

3. Backer Sheet Application: Heat Weld backer sheet to substrate as required by roofing system manufacturer.

4. Flashing Sheet Application Heat weld flashing sheet to substrate as required by roofing system manufacturer.

B. Extend base flashing up walls or parapets 8 inches (200 mm) above roofing membrane. Refer to manufacturer's standard flashing details.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in MBR Flashing cement.

D. Roof Drains: Flash drain using liquid applied flashing system. Clamp roofing membrane, flashing, and stripping into roof-drain clamping ring.

1. Install stripping according to roofing system manufacturer's written instructions.

E. Flash all penetrations using liquid applied flashing system.

3.08 EDGE METAL INSTALLATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Provide edge details as indicated on the Drawings. Install in accordance with the membrane manufacturer's requirements and SMACNA's "Architectural Sheet Metal Manual."

C. Join individual sections in accordance with the membrane manufacturer's requirements and SMACNA's "Architectural Sheet Metal Manual".

3.09 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.

1. Sweep away loose aggregate surfacing and set walkway pads in additional cold applied adhesive.

B. Walkway Cap Sheet Strips: Install roofing membrane walkway cap sheet strips over roofing membrane by heat weld application.

C. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways.

3.10 FIELD QUALITY CONTROL

A. Provide adequate number of experienced workmen regularly engaged in this type of work, skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and an experienced superintendent on the job site at all times that roofing work is in progress.

B. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

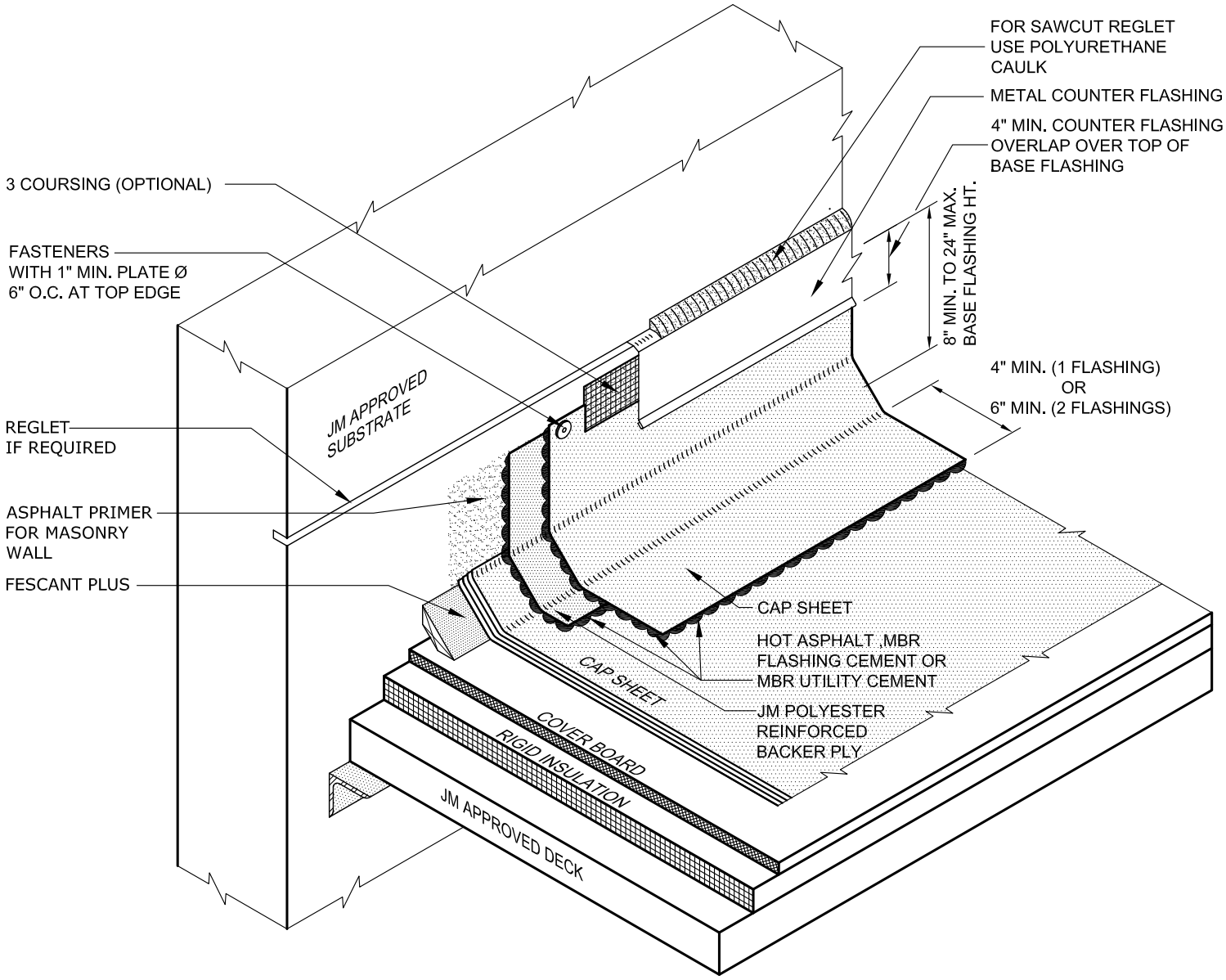
3.11 PROTECTION AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

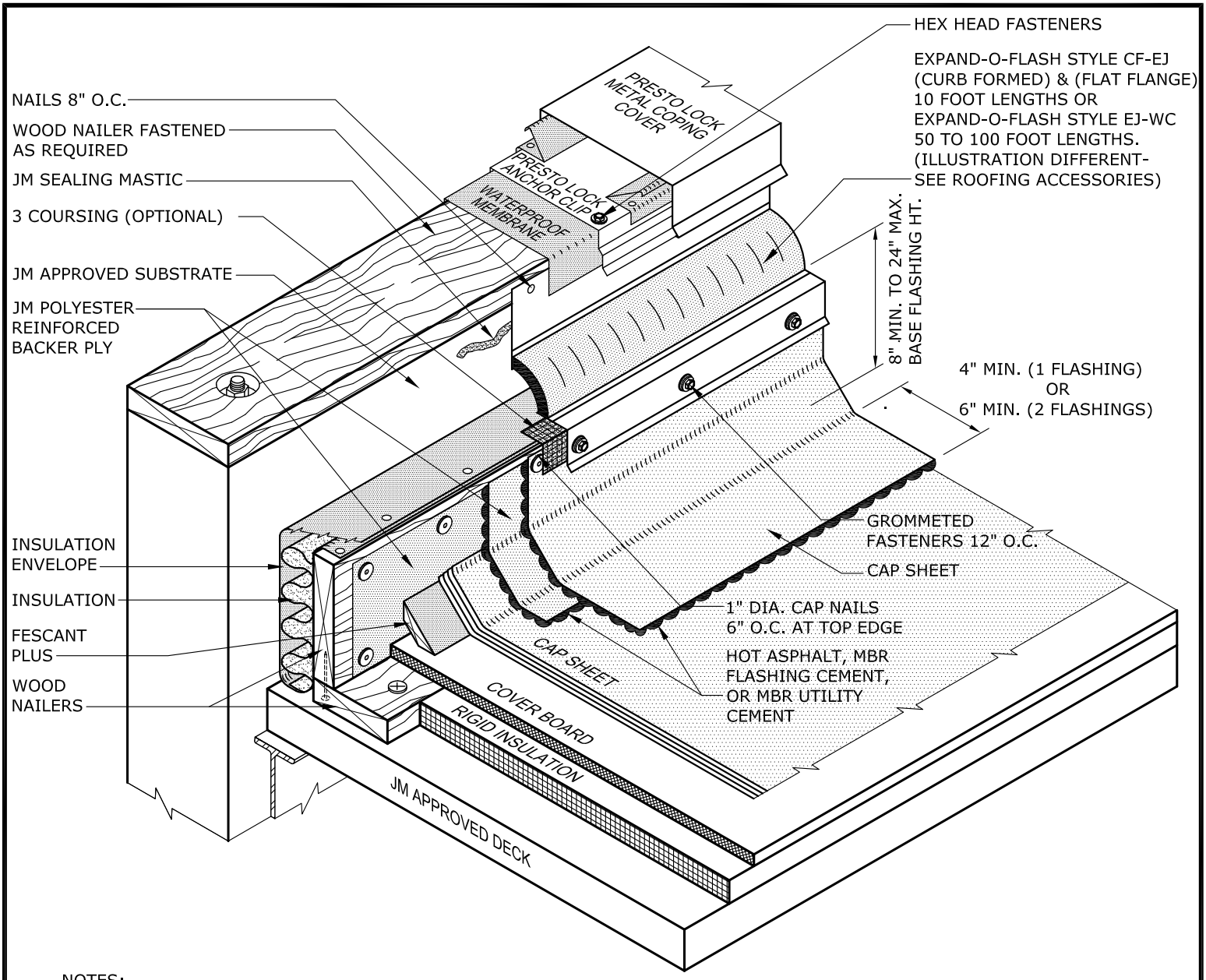
END OF SECTION



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.
4. METAL COUNTER FLASHING IS RECOMMENDED FOR ALL INSTALLATIONS AND IS REQUIRED FOR ALL GUARANTEES 15 YEARS OR LONGER. A 3 COURSING OF PERMAFLASH MAY BE USED TO SEAL THE TOP EDGE OF THE FLASHING ON 10 YEAR NDL'S IN LIEU OF METAL COUNTER FLASHING.
5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
7. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL

DRAWING NO. **BIT-1 (LB)** FLASHING WALL	BASE FLASHING FOR LOAD BEARING WALL W/ COUNTERFLASHING		
	MEMBRANE TYPE: BUR	Johns Manville is a manufacturer of commercial roofing products and offers this general conceptual information to you as a courtesy. This complimentary assistance is not to be used or relied upon by anyone as a substitute for professional engineering design and documentation required by building code, contract, or applicable law. By accepting these comments you agree they do not constitute any representations, endorsements of, or an assumption by Johns Manville of any liability for either the adequacy of the design of this building or any other material not supplied by Johns Manville.	
SCALE N.T.S / ISSUE DATE 02-06-19	MAXIMUM GUARANTEE TERM:		Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. INSTALL EXPAND-O-FLASH IN ACCORDANCE WITH APPLICATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED TRANSITIONS, INSIDE/OUTSIDE CORNERS, ETC. ARE AVAILABLE TO COMPLETE THE INSTALLATION.
4. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.
5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
7. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL
8. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.
BIT-1 (NLB)
FLASHING WALL

BASE FLASHING FOR NON LOAD BEARING WALL - CURB TO WALL E.J.

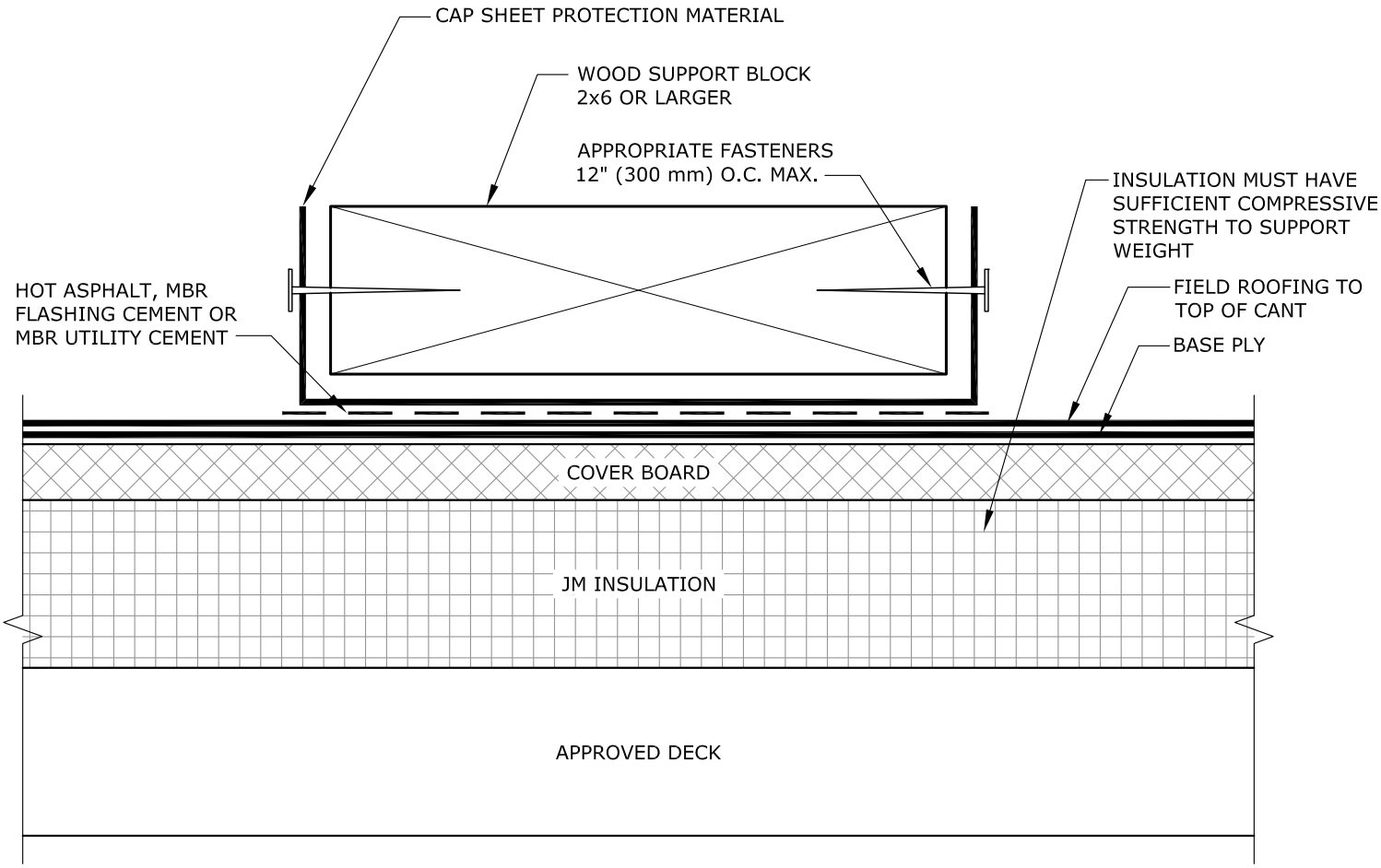
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-06-19

MAXIMUM GUARANTEE TERM:

Johns Manville



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2. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
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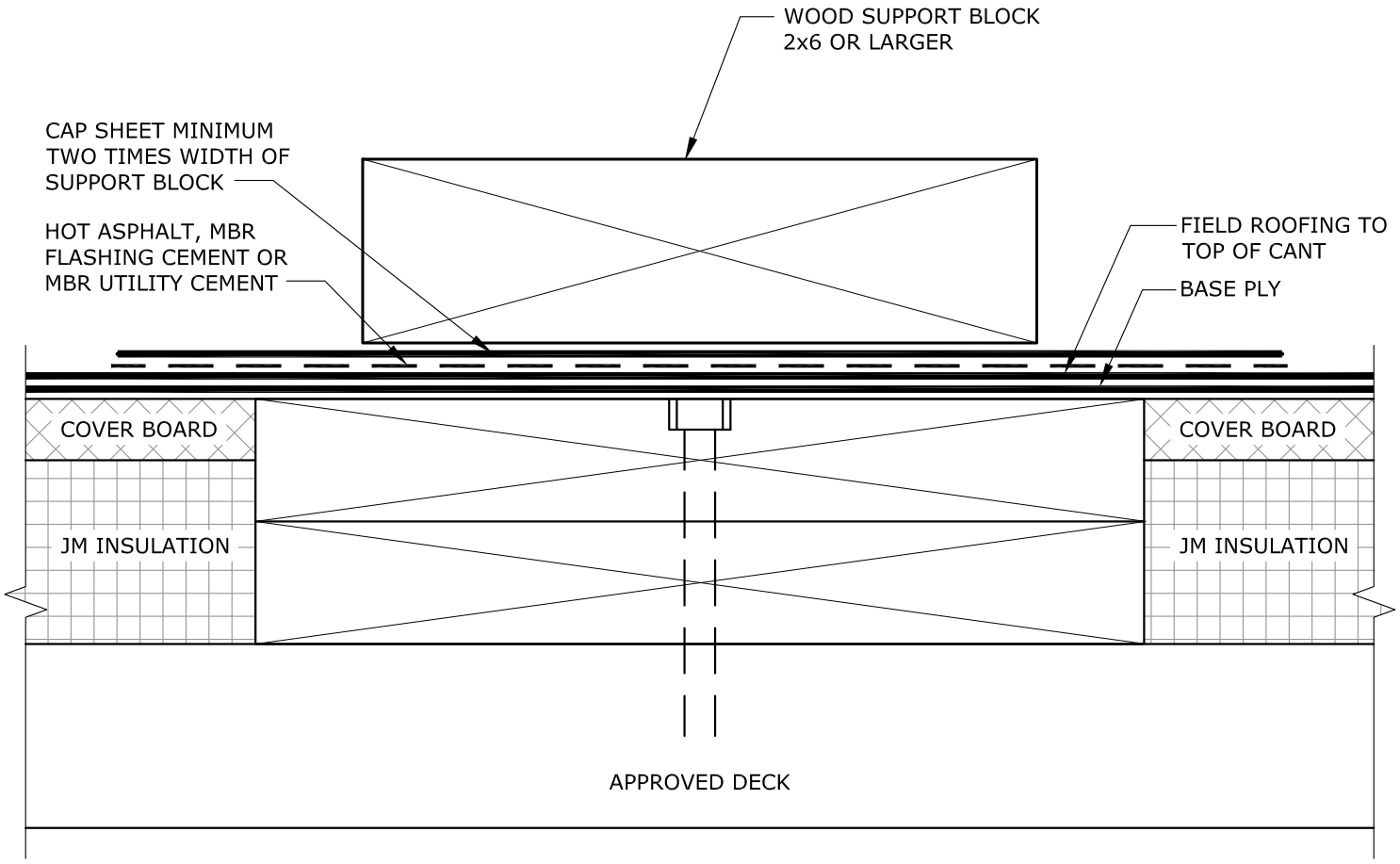
4. PLEASE SEE BITUMINOUS APPLICATION GUIDES FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.

DRAWING NO.	BITUMINOUS SUPPORT (LIGHT)	
BIT-PT-01 PROTECTION	MEMBRANE TYPE: JM SBS	Johns Manville is a manufacturer of commercial roofing products and offers this general conceptual information to you as a courtesy. This complimentary assistance is not to be used or relied upon by anyone as a substitute for professional engineering design and documentation required by building code, contract, or applicable law. By accepting these comments you agree they do not constitute any representations, endorsements of, or an assumption by Johns Manville of any liability for either the adequacy of the design of this building or any other material not supplied by Johns Manville.
SCALE N.T.S / ISSUE DATE 08-15-22	MAXIMUM GUARANTEE TERM: 30 YEAR	

Johns Manville



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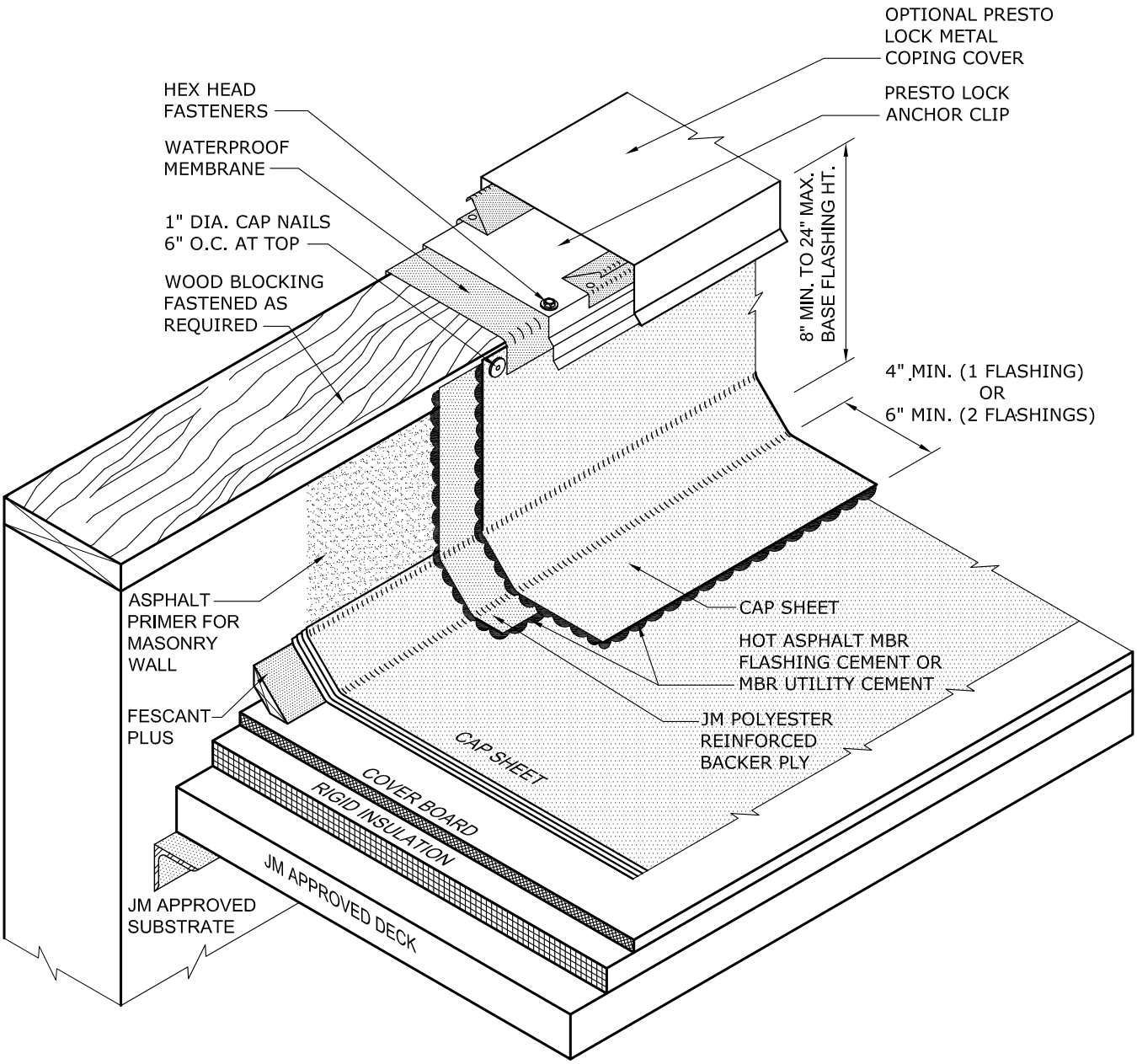
2. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
3. ANY CARPENTRY OR METAL WORK SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. PLEASE SEE BITUMINOUS APPLICATION GUIDES FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREME WHICH ARE CONSIDERED A PART OF THIS DETAIL.

DRAWING NO.	BITUMINOUS SUPPORT (MEDIUM)	
BIT-PT-02	MEMBRANE TYPE: JM SBS	Johns Manville is a manufacturer of commercial roofing products and offers this general conceptual information to you as a courtesy. This complimentary assistance is not to be used or relied upon by anyone as a substitute for professional engineering design and documentation required by building code, contract, or applicable law. By accepting these comments you agree they do not constitute any representations, endorsements of, or an assumption by Johns Manville of any liability for either the adequacy of the design of this building or any other material not supplied by Johns Manville.
PROTECTION		
SCALE: N.T.S / ISSUE DATE: 08-15-22	MAXIMUM GUARANTEE TERM: 30 YEAR	

Johns Manville



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5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
7. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.

DRAWING NO.
BIT-2 (WL)
FLASHING WALL

BASE FLASHING FOR WALL < 24" W/ COPING

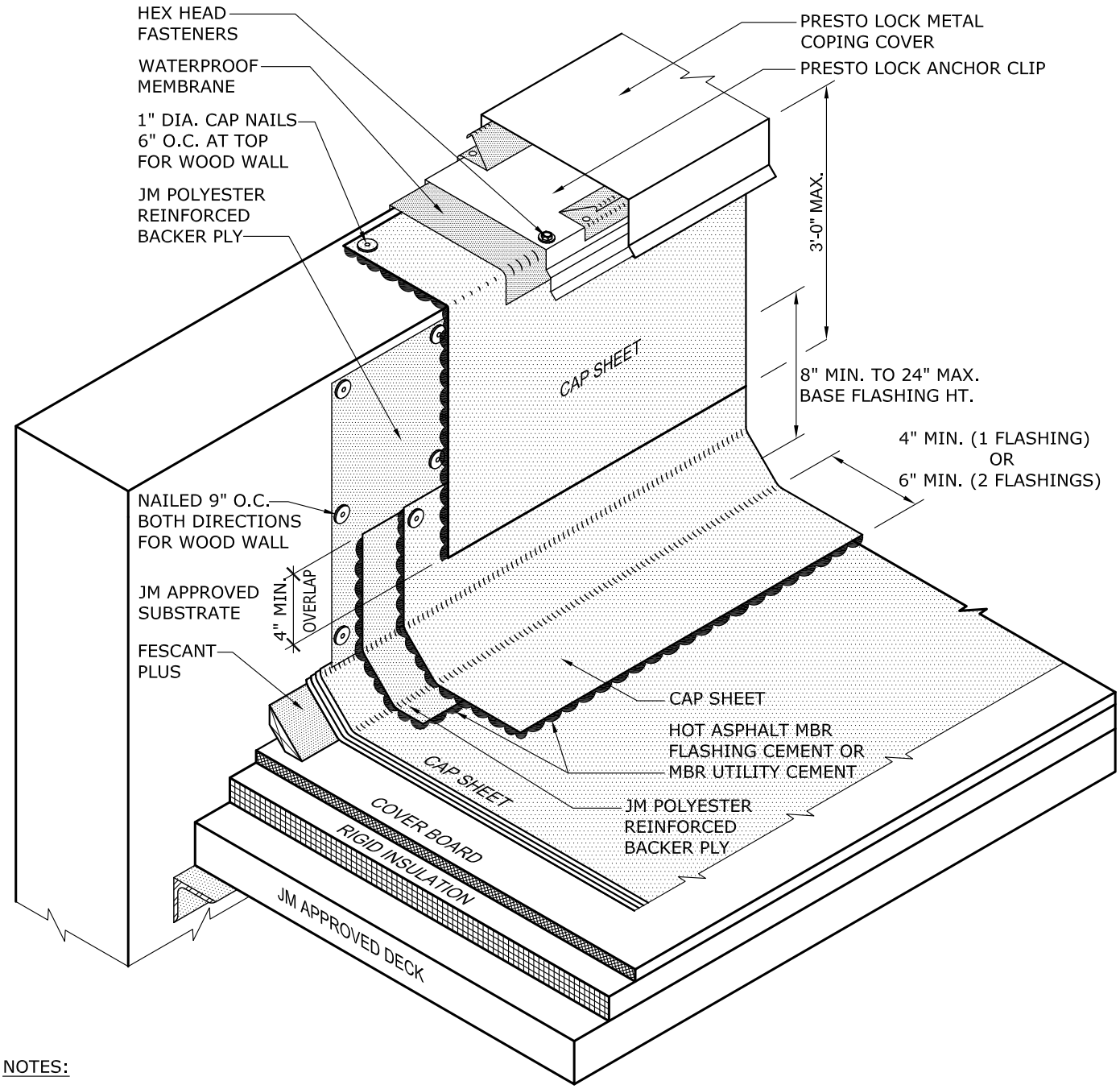
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-06-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.
4. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
5. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
6. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
7. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.
BIT-3 (WH)
FLASHING WALL

BASE FLASHING FOR WALL > 24" W/ COPING

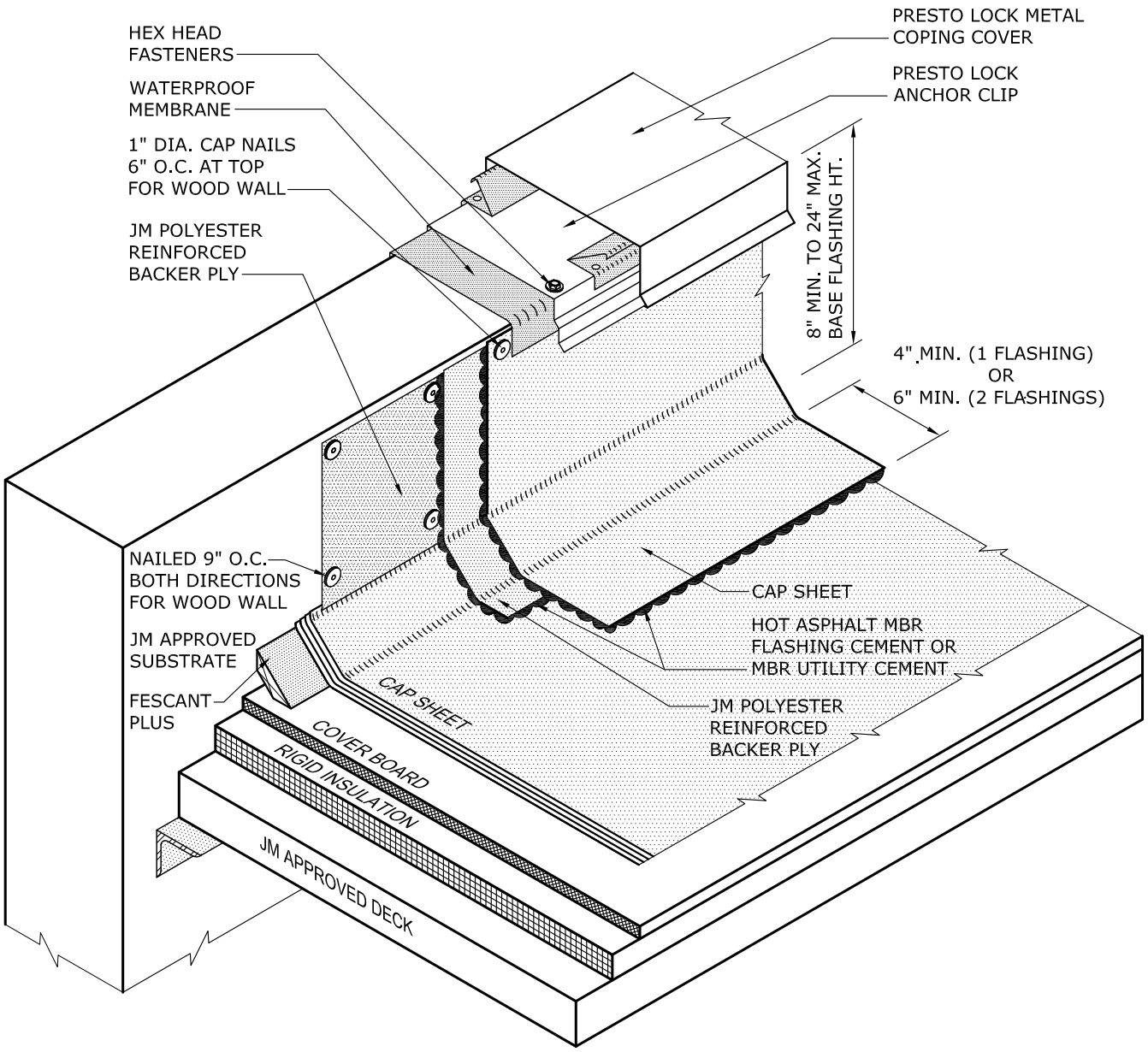
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-08-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY 9" O.C. IN BOTH DIRECTIONS.
4. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.
5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
7. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESXXXXIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL

DRAWING NO.
BIT-3 (WL)
FLASHING WALL

BASE FLASHING FOR WALL < 24" W/ COPING

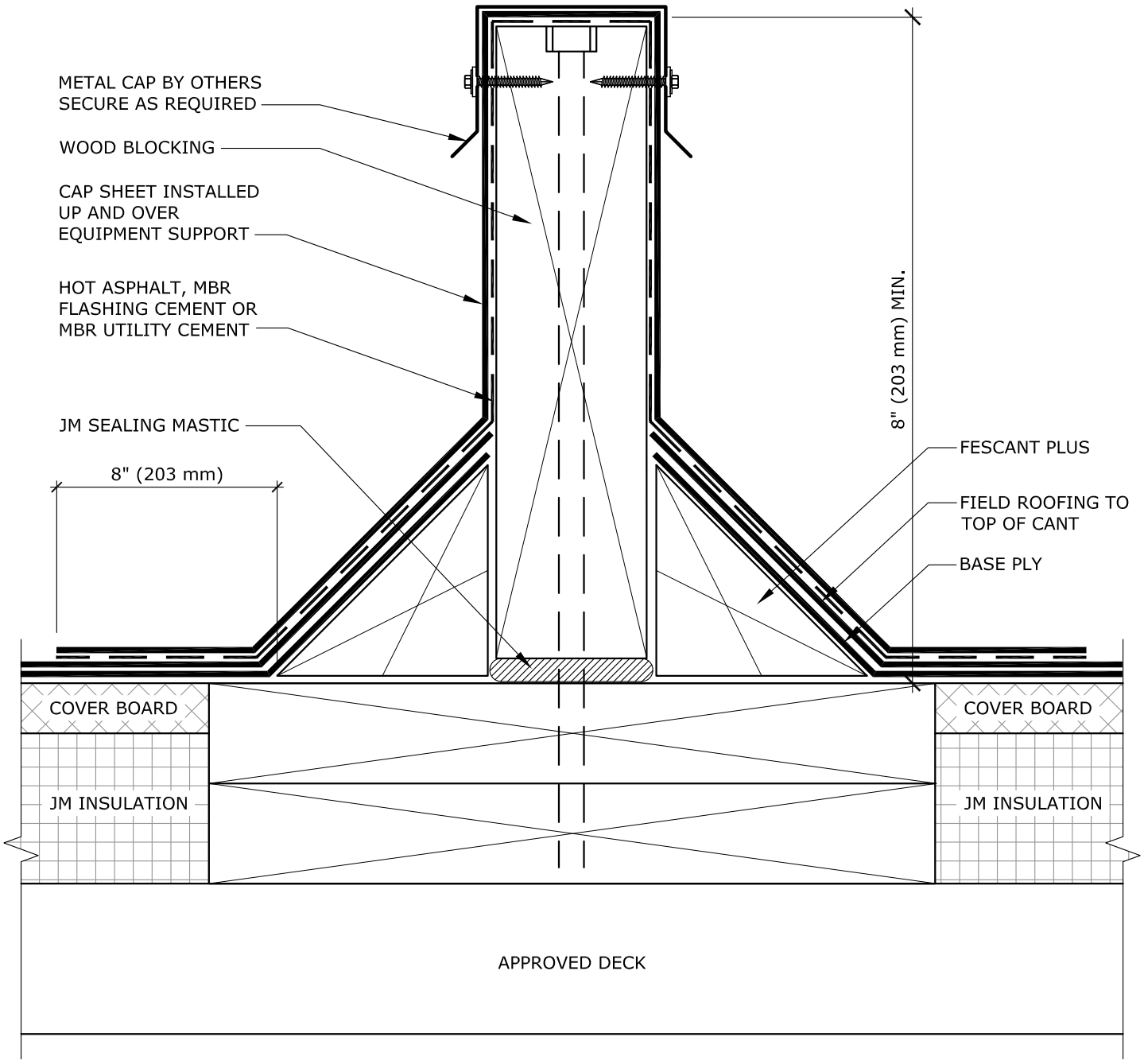
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-08-19

MAXIMUM GUARANTEE TERM:

Johns Manville

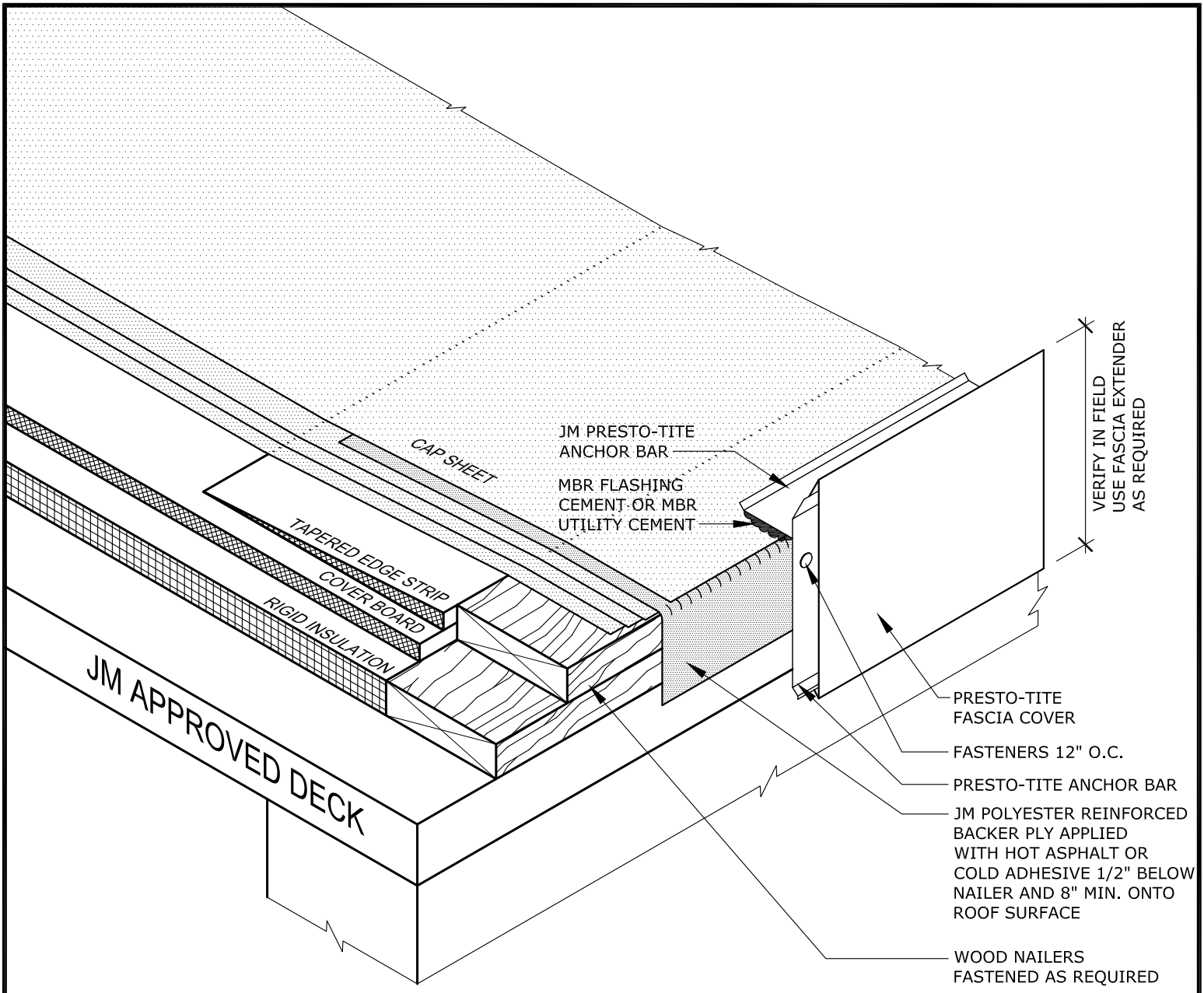


NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
3. ANY CARPENTRY OR METAL WORK SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. PLEASE SEE BITUMINOUS APPLICATION GUIDES FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.

DRAWING NO.	BITUMINOUS SUPPORT (HEAVY)	
BIT-PT-03	MEMBRANE TYPE: JM SBS	Johns Manville is a manufacturer of commercial roofing products and offers this general conceptual information to you as a courtesy. This complimentary assistance is not to be used or relied upon by anyone as a substitute for professional engineering design and documentation required by building code, contract, or applicable law. By accepting these comments you agree they do not constitute any representations, endorsements of, or an assumption by Johns Manville of any liability for either the adequacy of the design of this building or any other material not supplied by Johns Manville.
PROTECTION		
SCALE: N.T.S / ISSUE DATE: 08-15-22	MAXIMUM GUARANTEE TERM: 30 YEAR	

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. THE TAPERED EDGE STRIP (OPTIONAL), IS USED FOR NON-DRAINING EDGES TO KEEP PONDING WATER OFF THE FLASHING LAPS OR TO TRANSITION SUBSTRATE FLUSH WITH PERIMETER NAILER HEIGHT.
3. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. PRESTO LOCK GRAVEL STOP SHOULD BE INSTALLED IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS ARE AVAILABLE TO COMPLETE THE INSTALLATION.
5. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
6. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.

DRAWING NO.
BIT-4
FLASHING EDGE

ROOF EDGE WITH PRESTO-TITE

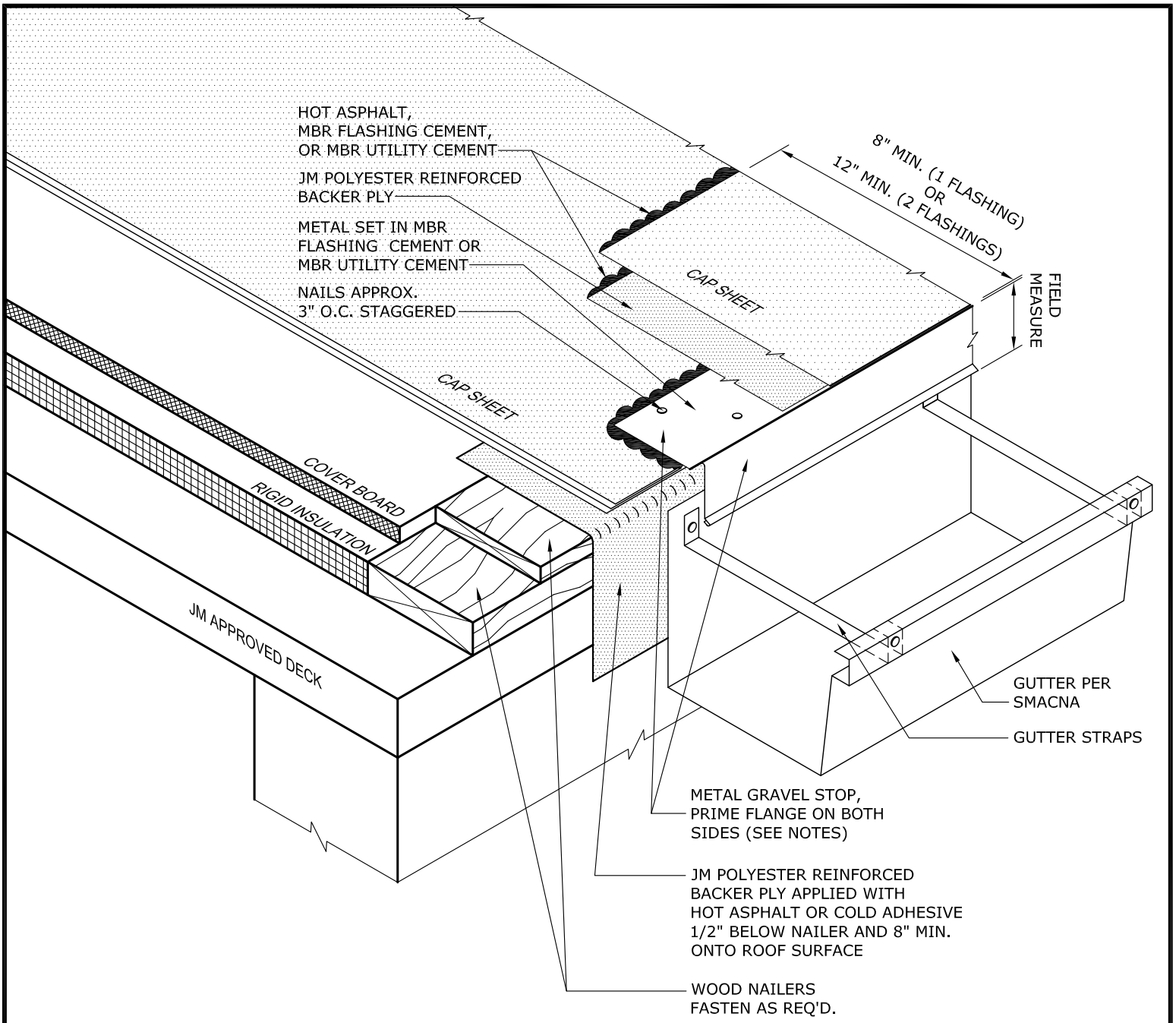
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-11-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. SHOP FABRICATED GRAVEL STOPS AND GUTTERS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA AND/OR NRCA GUIDELINES. GRAVEL STOP LAPS SHALL UTILIZE EITHER APPROVED SPLICE PLATES OR 4" MINIMUM OVERLAPS WITH APPROVED SEALANT.
5. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL
6. USE ASPHALT PRIMER ON GRAVEL STOP FLANGES WHEN USING MBR UTILITY CEMENT. USE PERMAFLASH PRIMER ON GRAVEL STOP FLANGES WHEN USING MBR FLASHING CEMENT.

DRAWING NO.

BIT-4 (GTR)

FLASHING EDGE

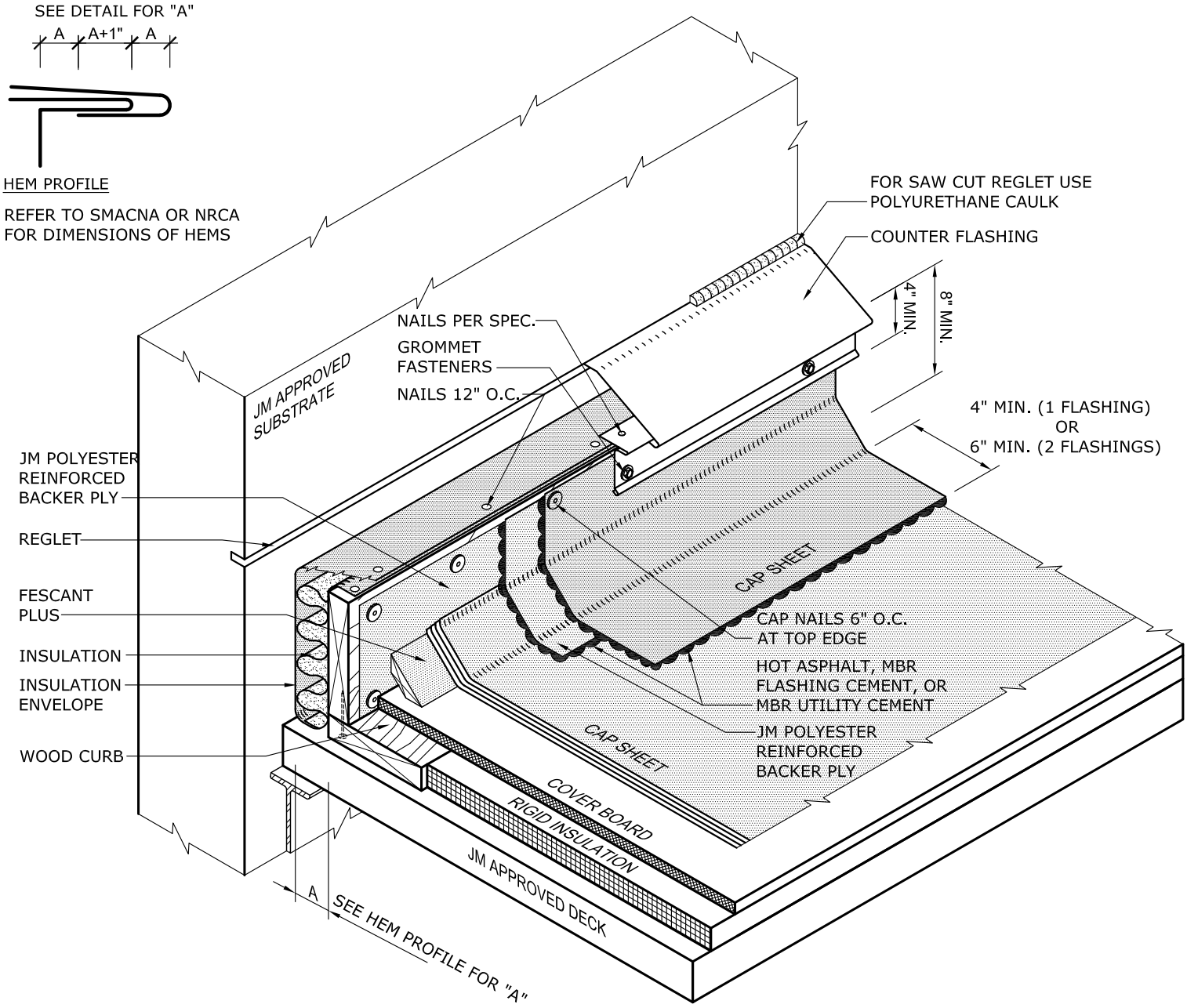
ROOF EDGE GUTTER

MEMBRANE TYPE:
BUR

SCALE	ISSUE DATE
N.T.S	02-11-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE OR DYNALASTIC 180 S.
3. SHOP FABRICATED METAL EXPANSION JOINT SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA OR NRCA. LAPS SHALL UTILIZE EITHER APPROVED SPLICE PLATES OR 4" MINIMUM OVERLAPS WITH APPROVED SEALANT.
4. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
7. THE VERTICAL WOOD CURB SHOULD BE FASTENED TO THE DECK ONLY.
8. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.
BIT-5
EXPANSION JOINTS

BASE FLASHING FOR NON LOAD BEARING WALL - METAL E.J. (ALTERNATE)

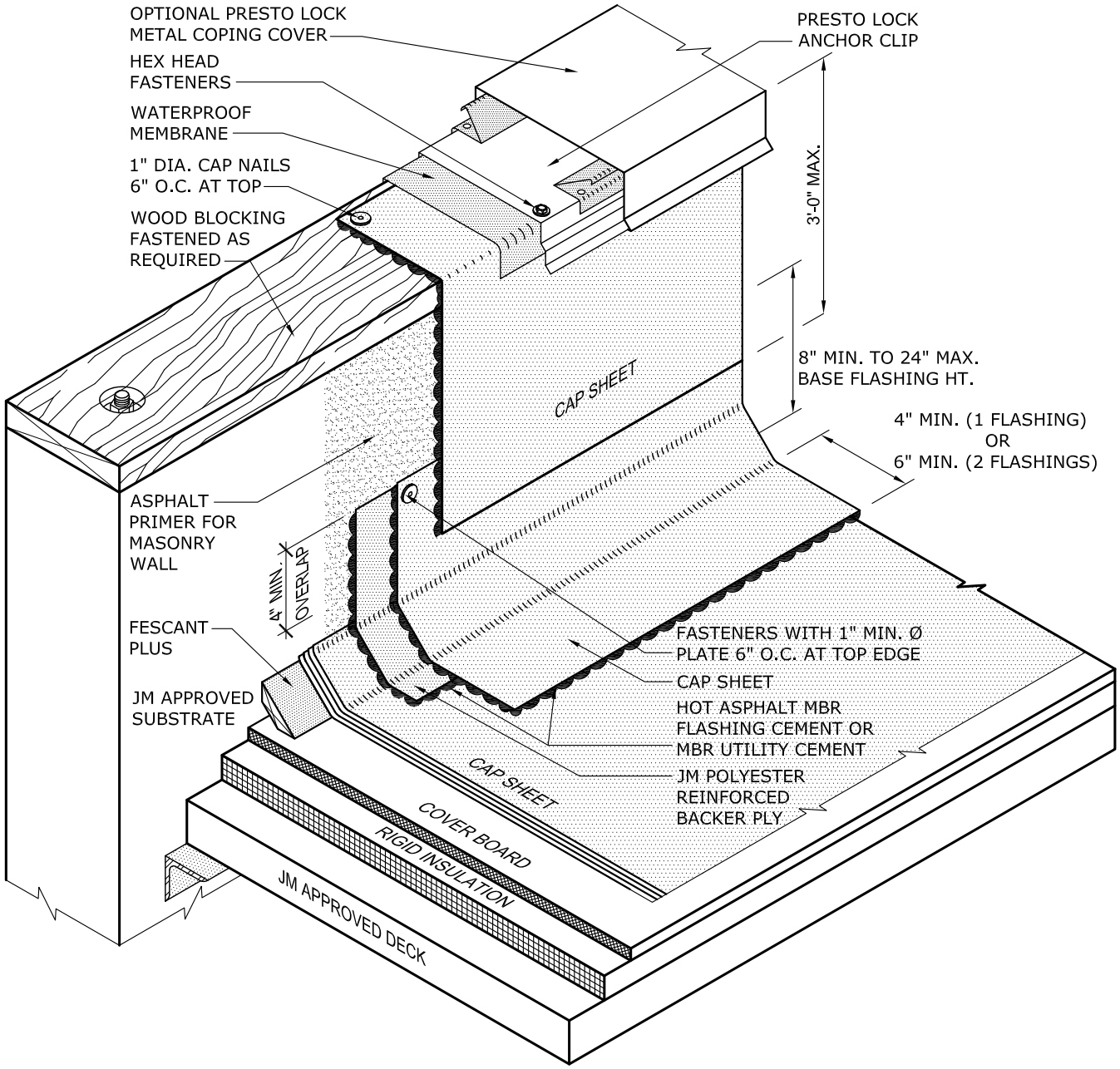
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-06-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. SHOP FABRICATED METAL EXPANSION JOINT SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA OR NRCA. LAPS SHALL UTILIZE EITHER APPROVED SPLICE PLATES OR 4" MINIMUM OVERLAPS WITH APPROVED SEALANT.
4. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
7. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.
8. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.

BIT-6 (TH)

FLASHING WALL

BASE FLASHING FOR WALL > 24" W/ COPING (ALTERNATE)

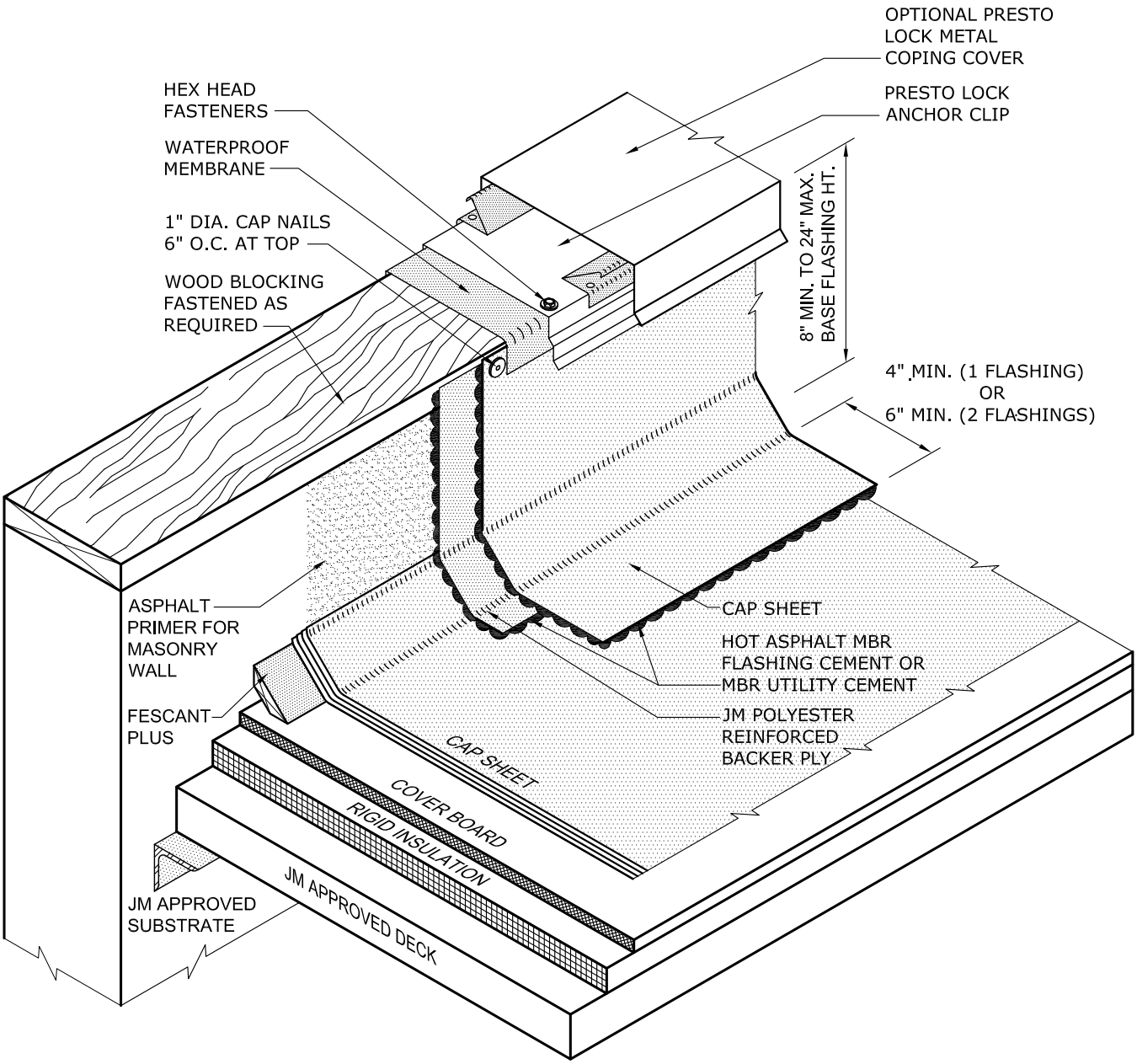
MEMBRANE TYPE: BUR

SCALE: N.T.S

ISSUE DATE: 02-08-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.
4. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
7. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.

DRAWING NO.
BIT-6 (TL)
FLASHING WALL

BASE FLASHING FOR WALL < 24" W/ COPING

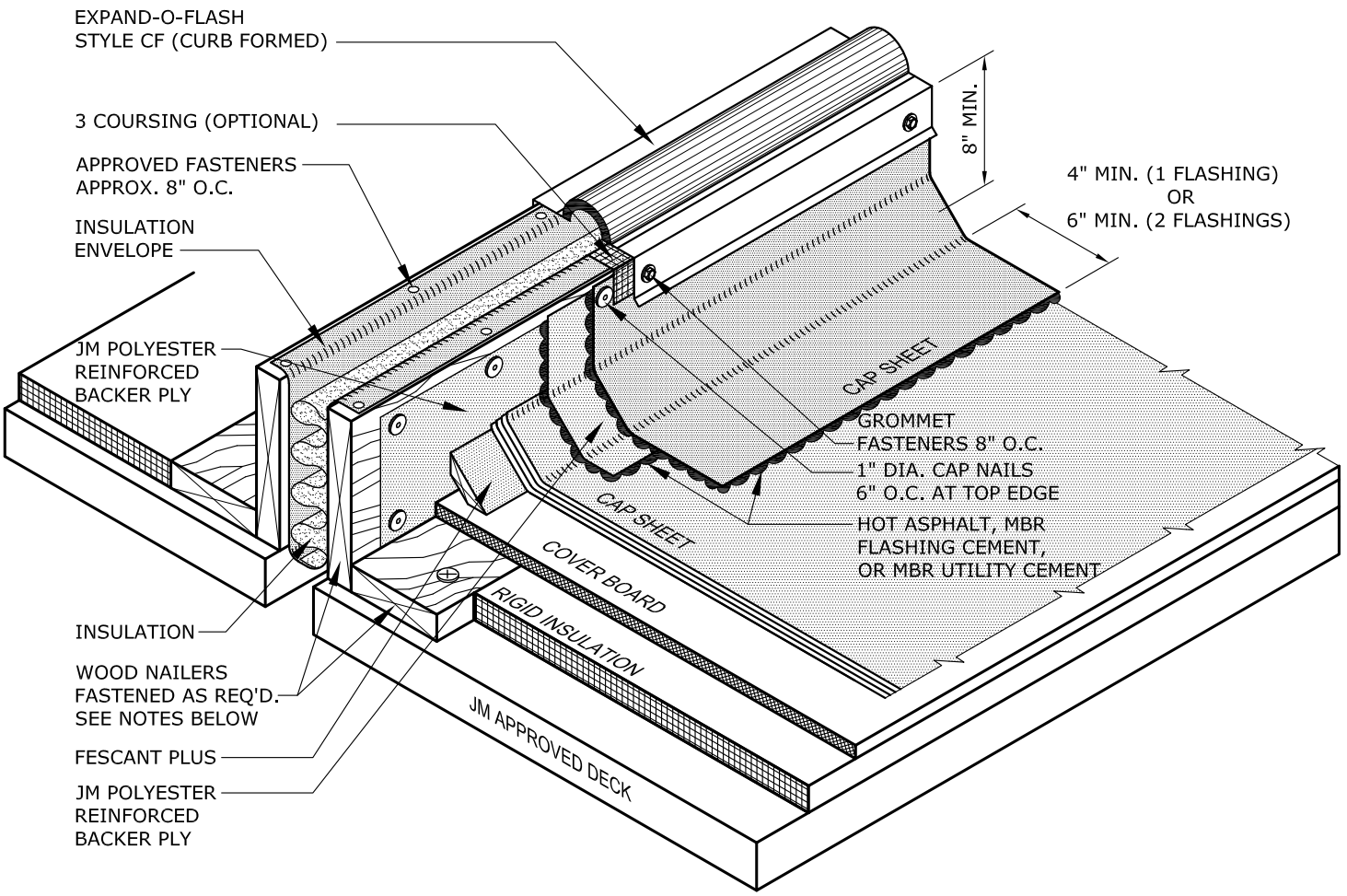
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-08-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
5. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
6. INSTALL EXPAND-O-FLASH IN ACCORDANCE WITH APPLICATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED TRANSITIONS, INSIDE/OUTSIDE CORNERS, ETC. ARE AVAILABLE TO COMPLETE THE INSTALLATION.
7. THE VERTICAL WOOD CURB SHOULD BE FASTENED TO THE DECK ONLY.

DRAWING NO.

BIT-7

EXPANSION JOINTS

CURB MOUNTED ROOF TO ROOF EXPANSION JOINT COVER

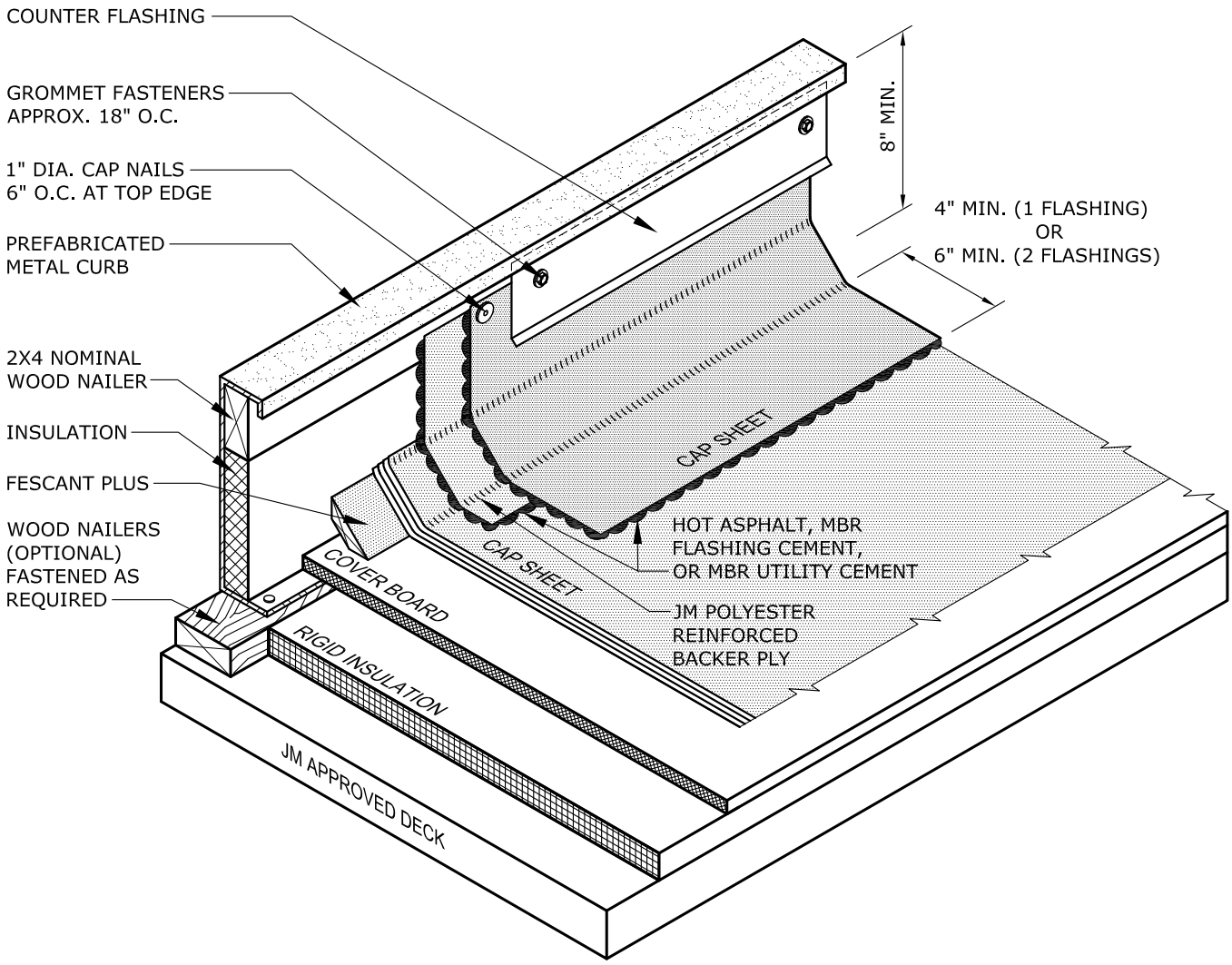
MEMBRANE TYPE: BUR

SCALE: N.T.S

ISSUE DATE: 02-06-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. HEIGHT OF CURB TO BE ADJUSTED WITH NAILERS. IT IS PREFERRED TO RAISE ROOF HATCH WITH NAILERS TO EXTEND FLASHING HEIGHT.
4. THE VERTICAL WOOD CURB SHOULD BE FASTENED TO THE DECK ONLY.
5. CURB INSULATION MUST BE MECHANICALLY ATTACHED OR ADHERED SOLIDLY TO METAL CURB.
6. CURB MUST BE SET SO AS TO PROVIDE 8" MIN FLASHING HEIGHT.
7. METAL COUNTERFLASHING IS REQUIRED FOR ALL INSTALLATIONS.
8. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
9. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
10. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.

DRAWING NO.
BIT-8
CURB & CORNER

PREFABRICATED CURB

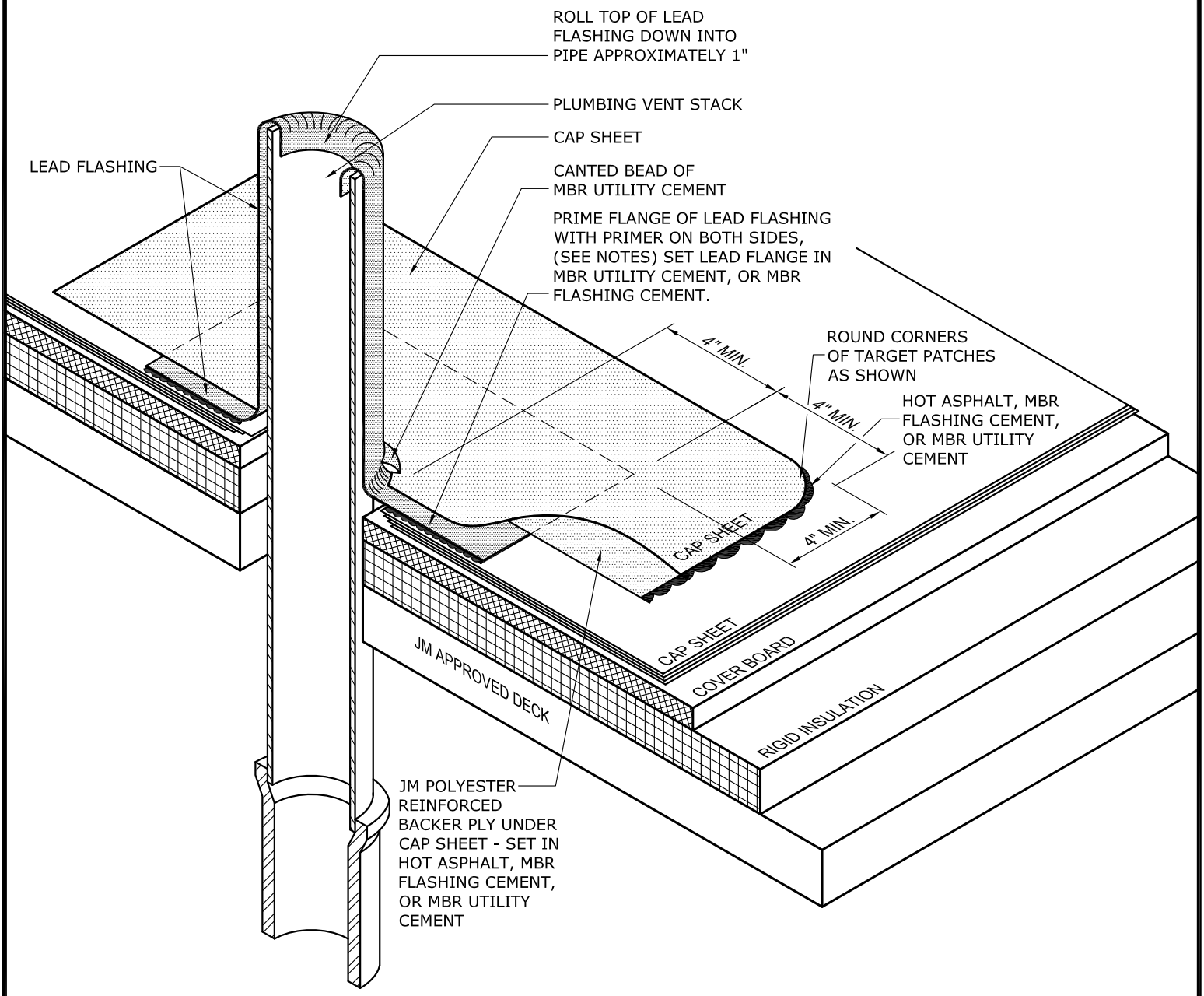
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-06-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. LEAD FLASHING SHALL BE 2.5 LBS. PER SQUARE FOOT MINIMUM.
3. IF LEAD FLASHING IS NOT DESIRED OR PIPE IS TOO TALL, SEE PERMAFLASH DETAIL PMF-6 & PMF-6S FOR A SUITABLE ALTERNATIVE.
4. USE ASPHALT PRIMER ON LEAD FLANGES WHEN USING MBR UTILITY CEMENT.
5. USE PERMAFLASH PRIMER ON LEAD FLANGES WHEN USING MBR FLASHING CEMENT.
6. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
7. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
8. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.

DRAWING NO.
BIT-9
DRAINS & VENTS

PLUMBING VENT

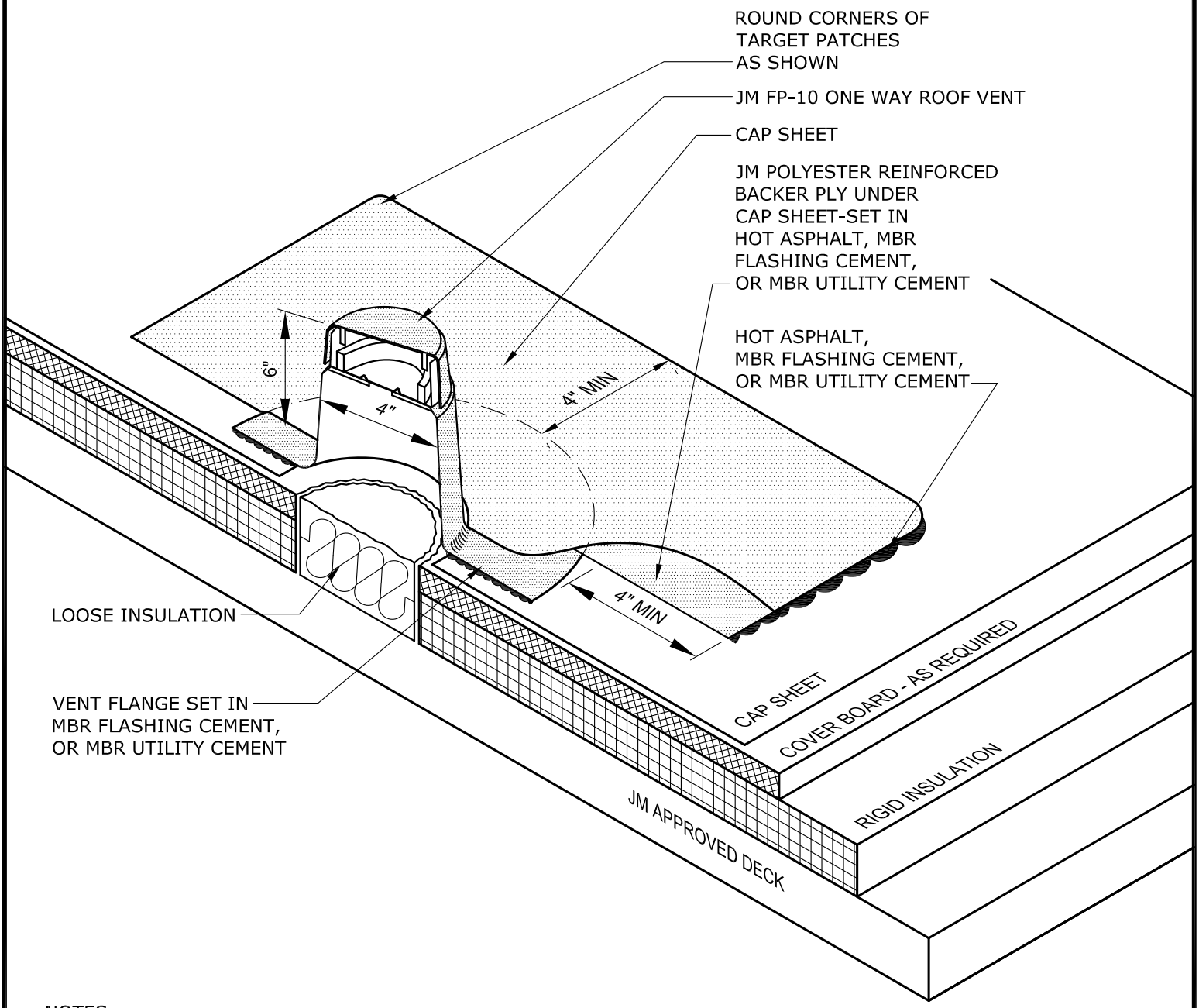
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-11-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. CUT A HOLE IN MEMBRANE PRIOR TO INSTALLATION. REMOVE ALL OR PART OF THE INSULATION TO FACILITATE VENTING. LOOSE INSULATION CAN REMAIN TO MAINTAIN R VALUE AND PREVENT CONDENSATION.
3. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
5. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.

DRAWING NO.
BIT-10
DRAINS & VENTS

ONE WAY ROOF VENT - FP10

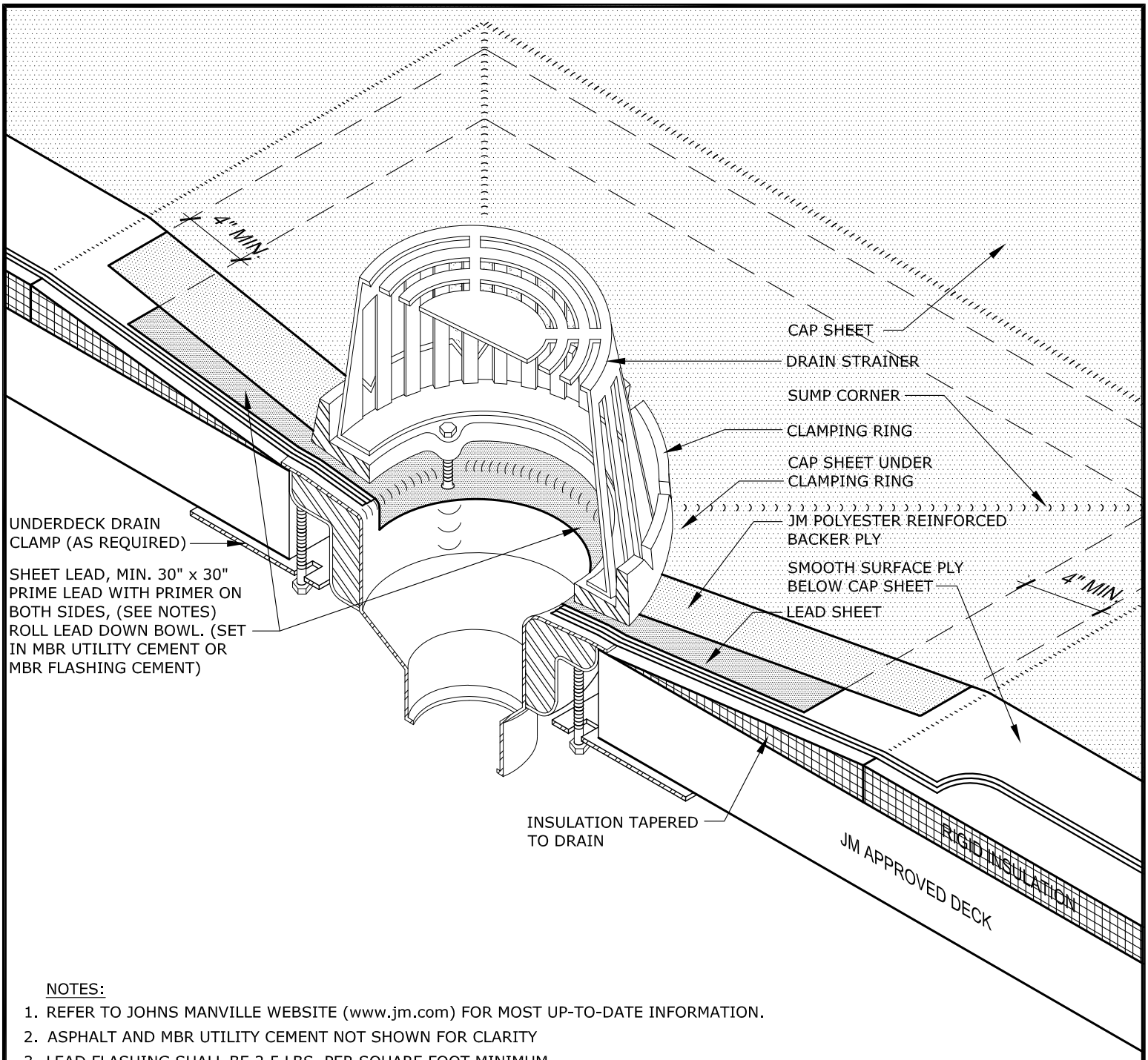
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-11-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. ASPHALT AND MBR UTILITY CEMENT NOT SHOWN FOR CLARITY
3. LEAD FLASHING SHALL BE 2.5 LBS. PER SQUARE FOOT MINIMUM.
4. IT IS ACCEPTABLE TO RUN FIELD MEMBRANE PLY THROUGH DRAIN CENTER AND OMIT TARGET SHEET IF DRAIN SUMP IS SHALLOW ENOUGH TO ALLOW INSTALLATION WITHOUT WRINKLES OR FISHMOUTHS. STEEP SUMPS WILL REQUIRE THE INSTALLATION OF A TARGET PATCH WITHIN DRAINSUMP.
5. USE ASPHALT PRIMER ON LEAD FLANGES WHEN USING MBR UTILITY CEMENT. USE PERMAFLASH PRIMER ON LEAD FLANGES WHEN USING MBR FLASHING CEMENT.
6. EXTEND ALL PLIES TO EDGE OF DRAIN BOWL. NO SEAMS ARE ALLOWED THROUGH THE DRAIN.
7. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
8. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
9. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.

DRAWING NO.
BIT-11
DRAINS & VENTS

METAL DRAIN

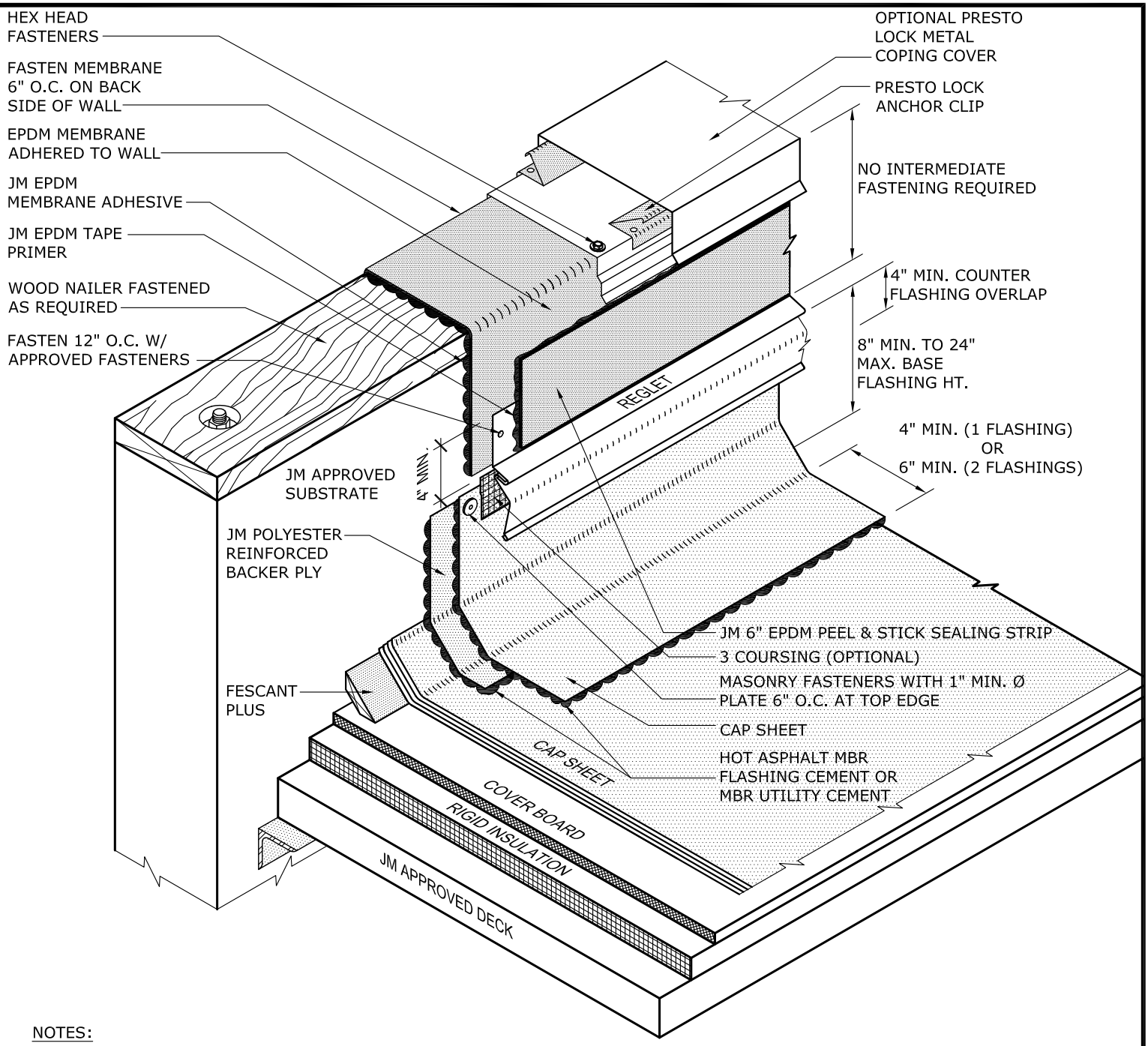
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-11-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.
4. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS AND THE JM EPDM APPLICATION GUIDE FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL
5. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
6. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
7. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.

BIT-15 (E) Alt

FLASHING WALL

EPDM WALL COVERING WITH BUR BASE FLASHING

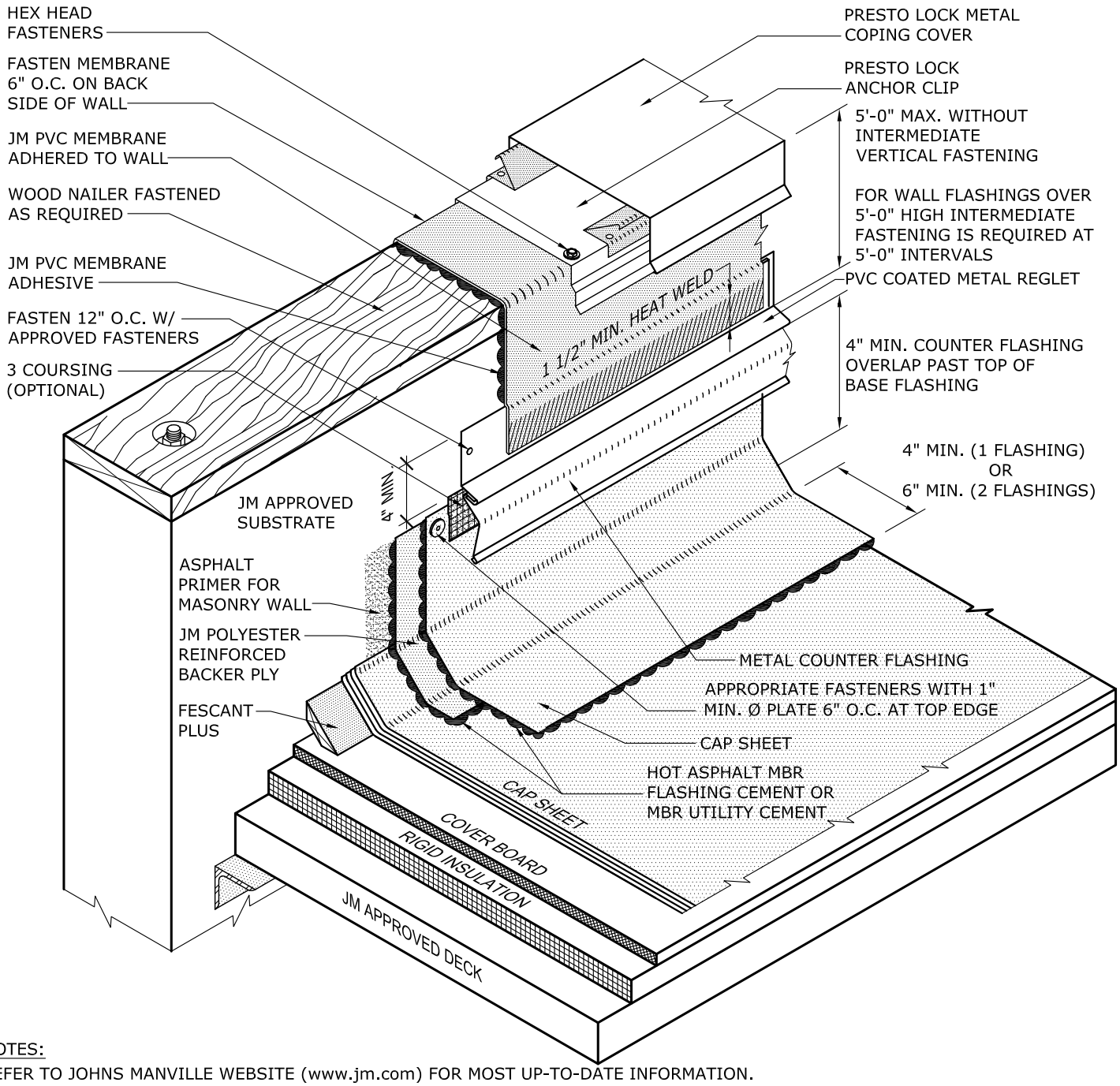
MEMBRANE TYPE: BUR

SCALE: N.T.S

ISSUE DATE: 02-08-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.
5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS AND THE JM PVC APPLICATION GUIDE FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
7. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.

BIT-15 (P)

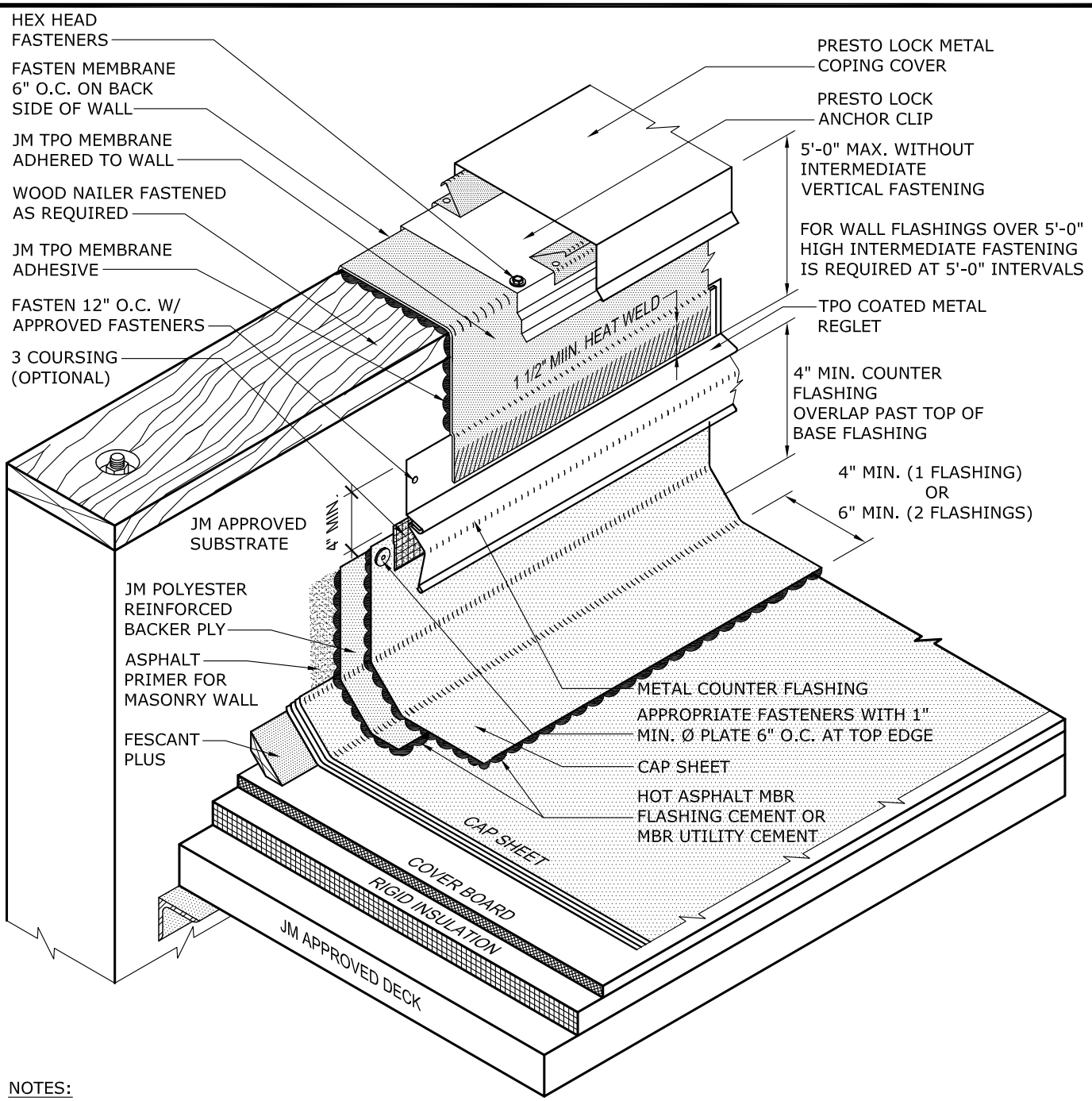
FLASHING WALL

PVC WALL COVERING WITH BUR BASE FLASHING

MEMBRANE TYPE: BUR

SCALE	ISSUE DATE	MAXIMUM GUARANTEE TERM:
N.T.S	02-08-19	

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
3. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. INSTALL PRESTO LOCK COPING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS INCLUDED WITH THE PRODUCT. PREFABRICATED INSIDE/OUTSIDE CORNERS AND END CAPS ARE AVAILABLE TO COMPLETE THE INSTALLATION. SHOP FABRICATED COPINGS SHOULD BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES.
5. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
6. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS AND THE JM TPO APPLICATION GUIDE FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
7. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.
BIT-15 (T)
FLASHING WALL

TPO WALL COVERING WITH BUR BASE FLASHING

MEMBRANE TYPE:
BUR

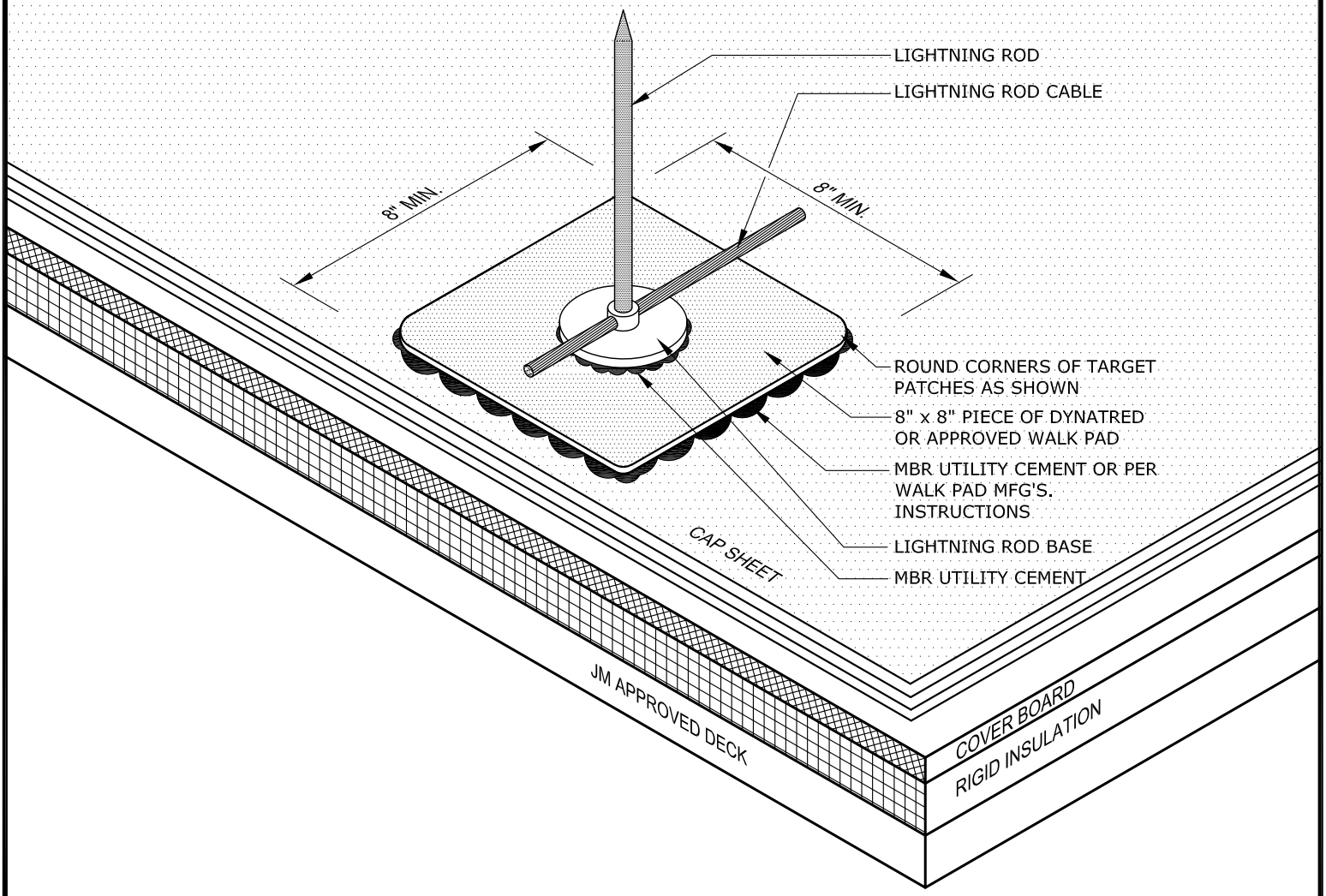
SCALE
N.T.S

ISSUE DATE
02-08-19

MAXIMUM GUARANTEE TERM:

Johns Manville

JM DOES NOT EVALUATE OR RECOMMEND ANY LIGHTNING PROTECTION MANUFACTURERS PRODUCTS. THE LIGHTNING PROTECTION DEVICES SHOWN ARE FOR GRAPHIC REPRESENTATION ONLY AND ARE NOT COVERED UNDER ANY JM GUARANTEE.



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
3. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
4. LIGHTNING ROD GROUND WIRE MUST NOT COME IN CONTACT WITH THE ROOFING MATERIAL. A SACRIFICIAL LAYER OF MEMBRANE IS RECOMMENDED UNDER THE ENTIRE LENGTH OF GROUND WIRE(S).

DRAWING NO.
BIT-17
PROTECTION

LIGHTNING ROD ON ROOF SURFACE

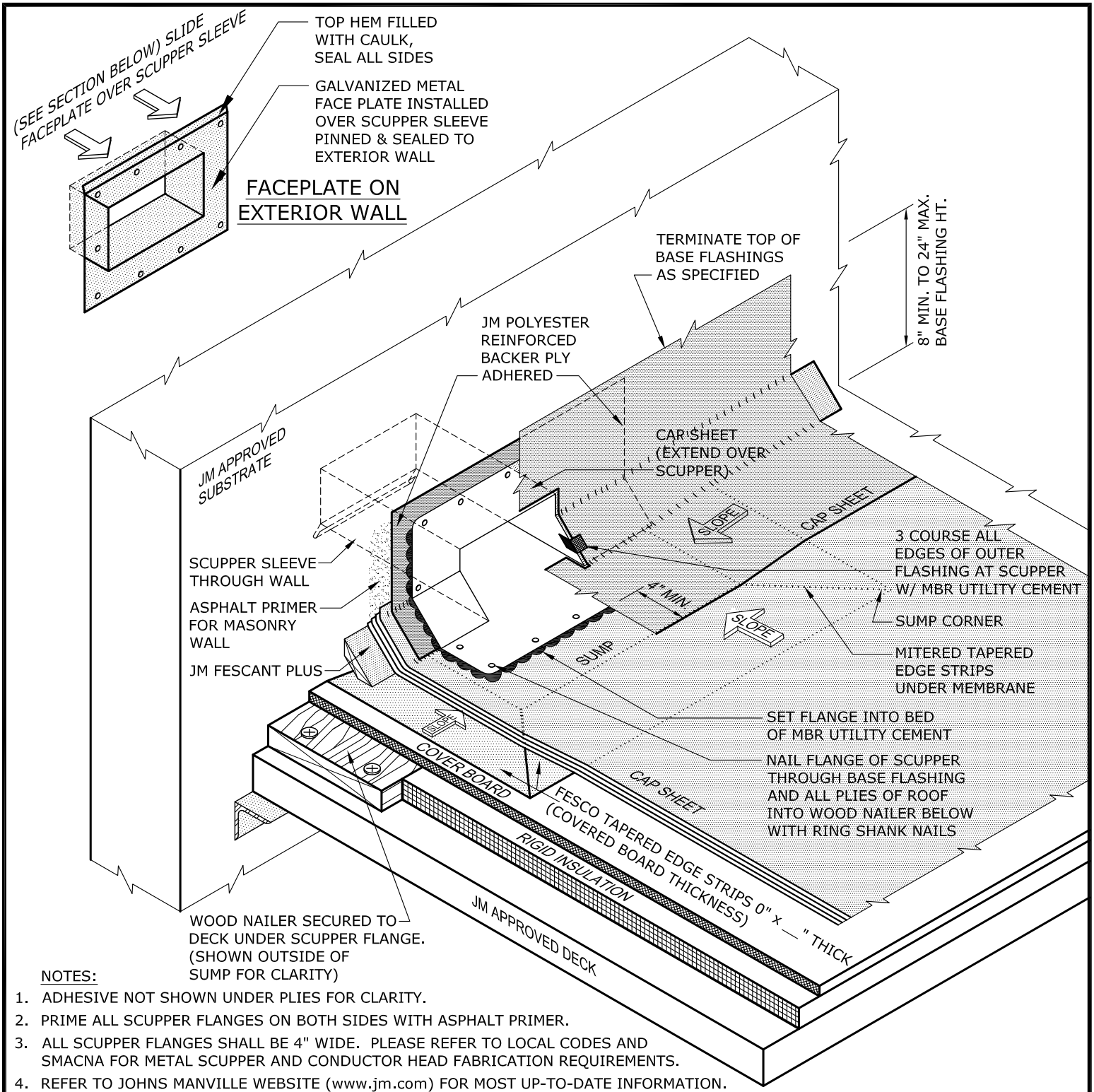
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-11-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. ADHESIVE NOT SHOWN UNDER PLIES FOR CLARITY.
2. PRIME ALL SCUPPER FLANGES ON BOTH SIDES WITH ASPHALT PRIMER.
3. ALL SCUPPER FLANGES SHALL BE 4" WIDE. PLEASE REFER TO LOCAL CODES AND SMACNA FOR METAL SCUPPER AND CONDUCTOR HEAD FABRICATION REQUIREMENTS.
4. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
5. SCUPPER FACEPLATE ON EXTERIOR SHOWN AS AN EXAMPLE.
6. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
7. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
8. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
9. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.
BIT-21
DRAINS & VENTS

PRIMARY METAL SCUPPER IN SUMP

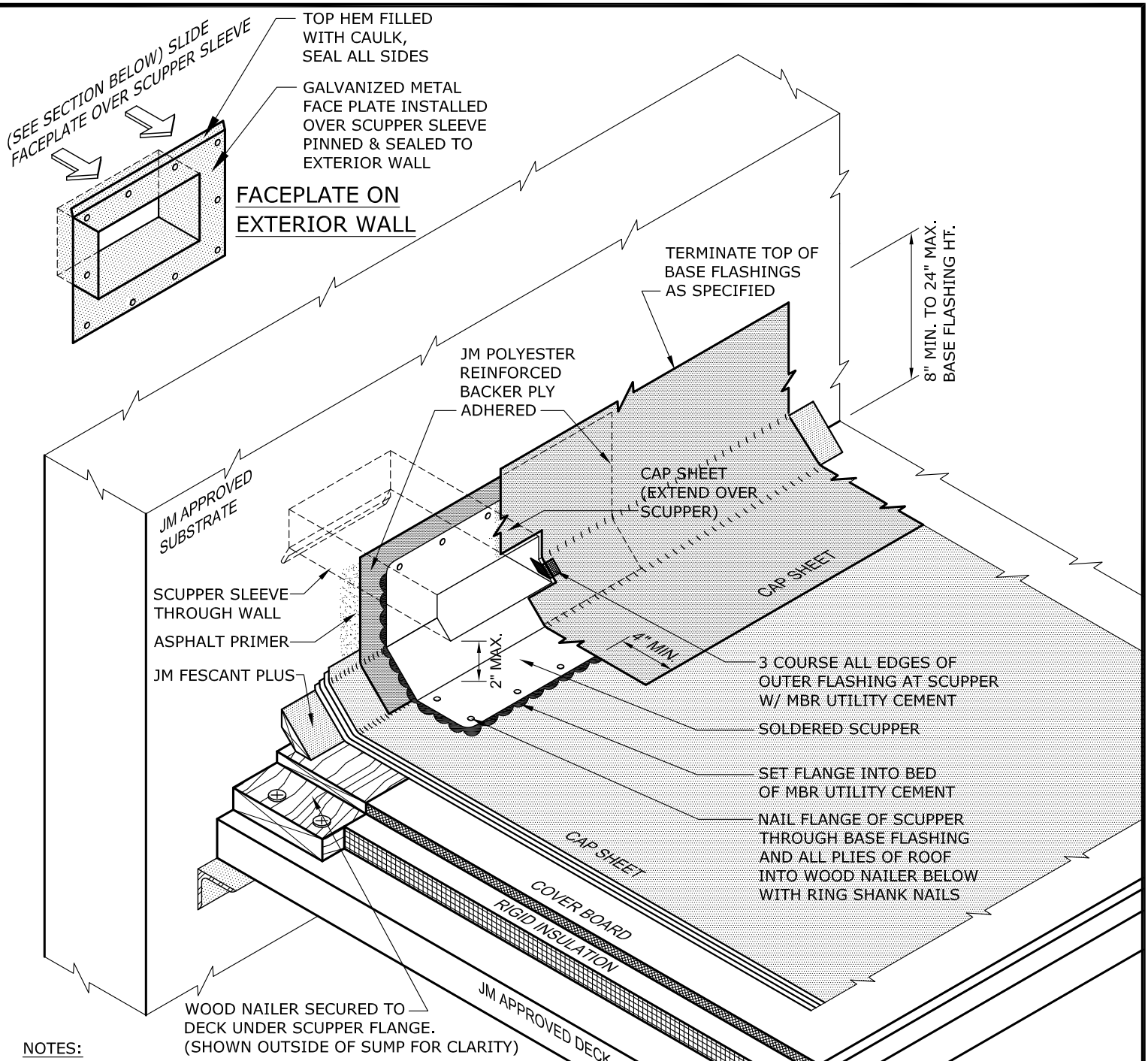
MEMBRANE TYPE:
BUR

SCALE
N.T.S

ISSUE DATE
02-11-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. ADHESIVE NOT SHOWN UNDER PLIES FOR CLARITY.
2. SCUPPER FACEPLATE ON EXTERIOR SHOWN AS AN EXAMPLE.
3. PRIME ALL SCUPPER FLANGES ON BOTH SIDES WITH ASPHALT PRIMER.
4. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
5. ALL SCUPPER FLANGES SHALL BE 4" WIDE. PLEASE REFER TO LOCAL CODES AND SMACNA FOR METAL SCUPPER AND CONDUCTOR HEAD FABRICATION REQUIREMENTS.
6. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
7. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
8. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
9. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.
BIT-22
DRAINS & VENTS

OVERFLOW METAL SCUPPER

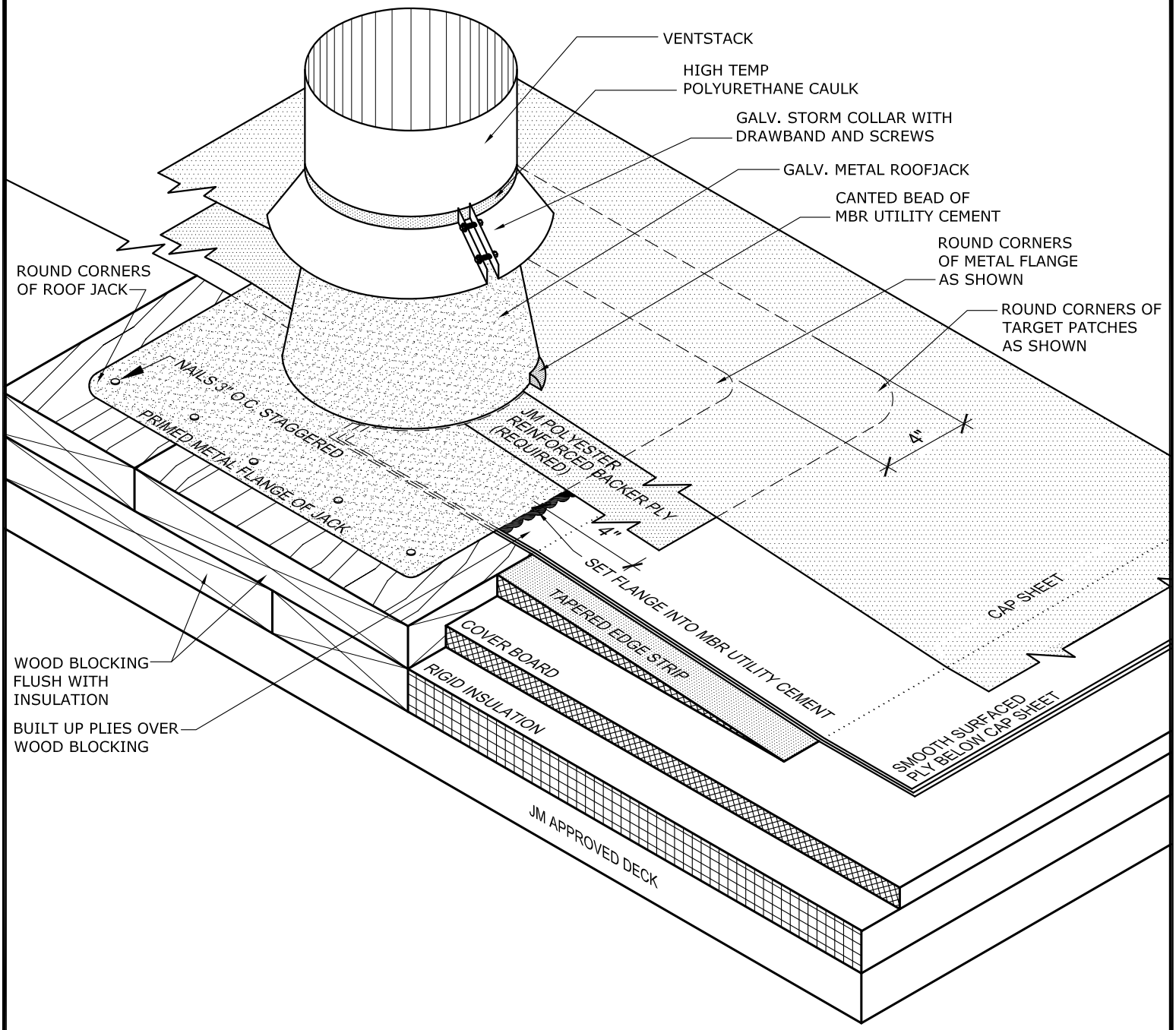
MEMBRANE TYPE: BUR

SCALE: N.T.S

ISSUE DATE: 02-11-19

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
3. ANY CARPENTRY, METAL WORK, OR MASONRY CONSTRUCTION SHOULD BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS AND/OR PROJECT SPECIFICATIONS. THESE COMPONENTS SHOULD BE REVIEWED AND APPROVED BY A LICENSED DESIGN PROFESSIONAL.
4. SEAL SEAMS OF ROOF JACK.
5. DISTANCE BETWEEN TOP OF ROOF JACK AND VENT STACK SHOULD BE A MINIMUM OF 1".
6. THE TAPERED EDGE STRIP IS OPTIONAL. THE NAILERS AND ROOF SUBSTRATE MUST BE FLUSH.
7. FLASHING ROOF JACK WITH A TARGET PATCH OVER CAP SHEET IS ACCEPTABLE. SEE DFE-9 FOR TYPICAL FLASHING INSTALLATION.

DRAWING NO.
BIT-23
DRAINS & VENTS

VENT STACK (WARM)

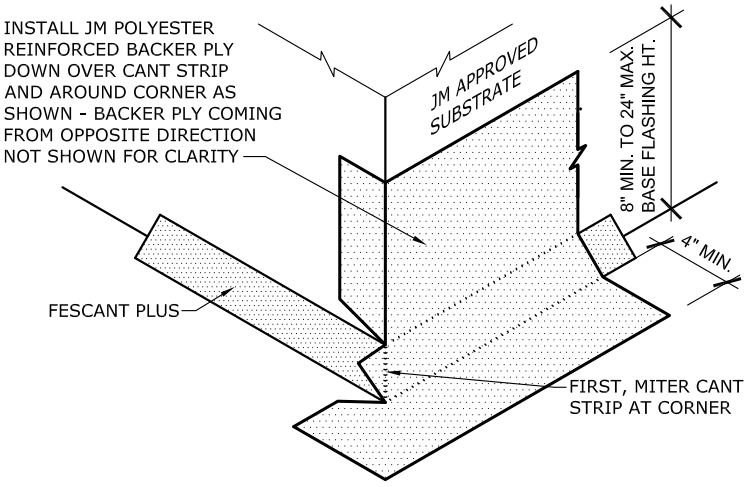
MEMBRANE TYPE:
BUR

SCALE
N.T.S

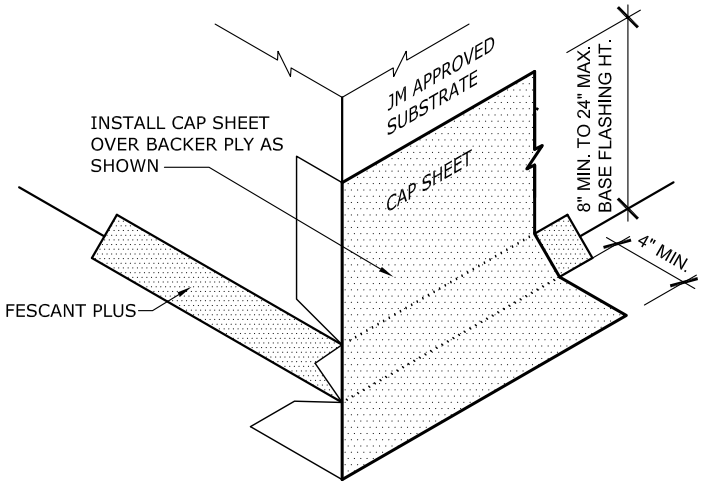
ISSUE DATE
02-11-19

MAXIMUM GUARANTEE TERM:

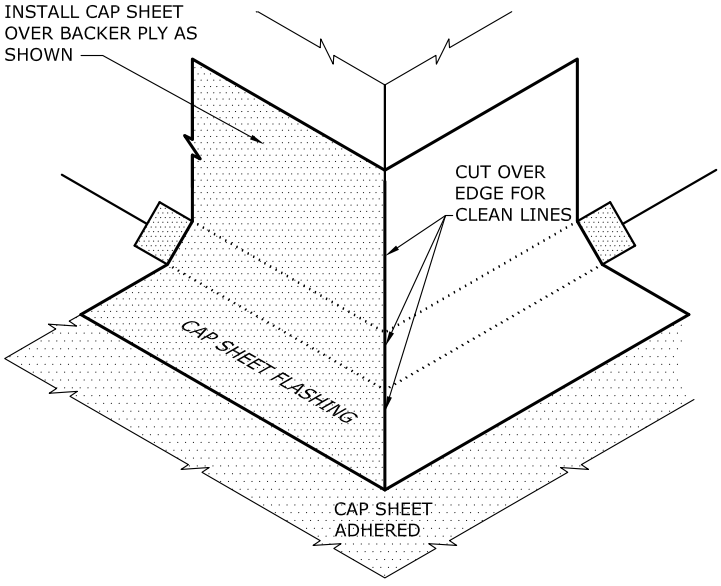
Johns Manville



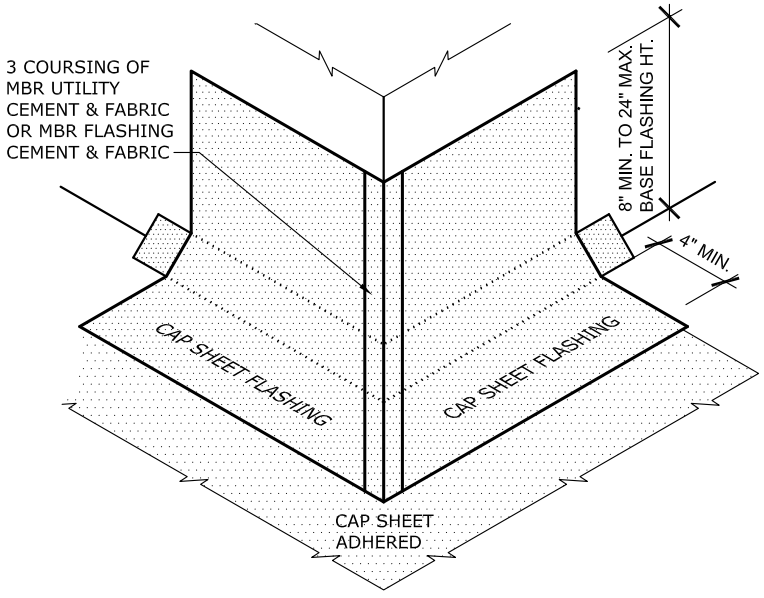
STEP 1



STEP 2



STEP 3



STEP 4

NOTES:

1. REFER TO JOHNS MANVILLE WEBSITE (www.jm.com) FOR MOST UP-TO-DATE INFORMATION.
2. 3-COURSING WITH MBR UTILITY CEMENT & FABRIC OR MBR FLASHING CEMENT & FABRIC MUST BE USED ALONG EDGE OF BASE FLASHING AS DEPICTED IN STEP 4.
3. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
4. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
5. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
6. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.

BIT-26

CURB & CORNER

BASE FLASHING AT OUTSIDE CORNER

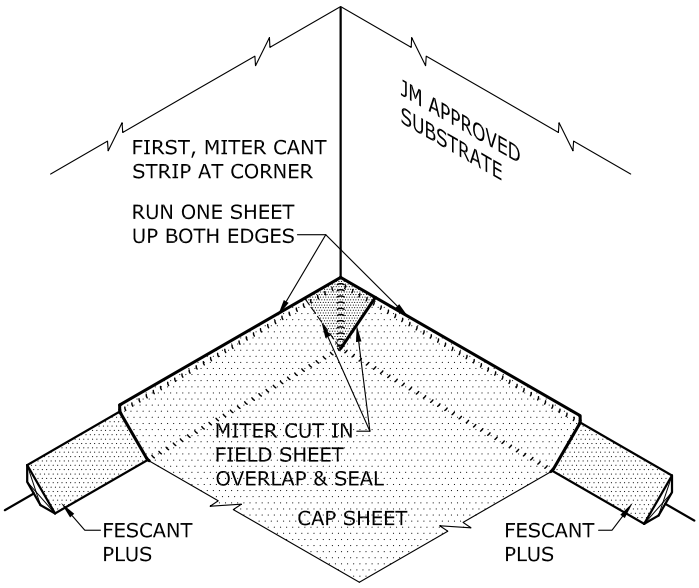
SCALE	ISSUE DATE
N.T.S	07-08-21

MEMBRANE TYPE: BUR

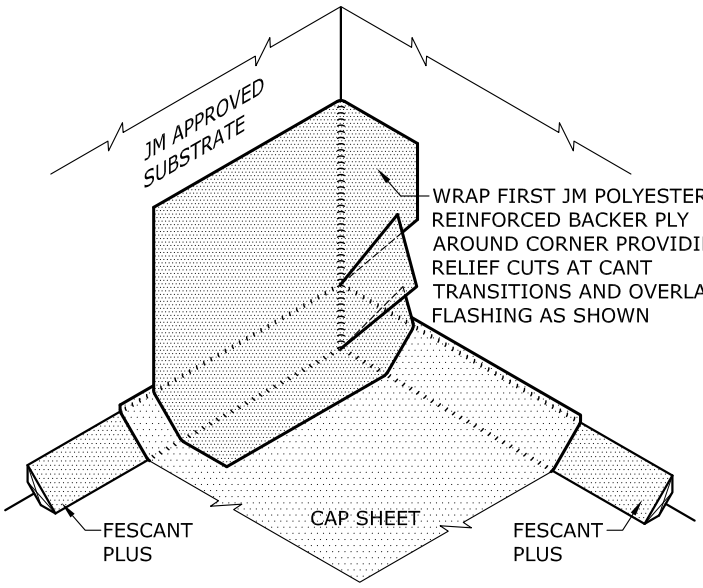
MAXIMUM GUARANTEE TERM:

Johns Manville

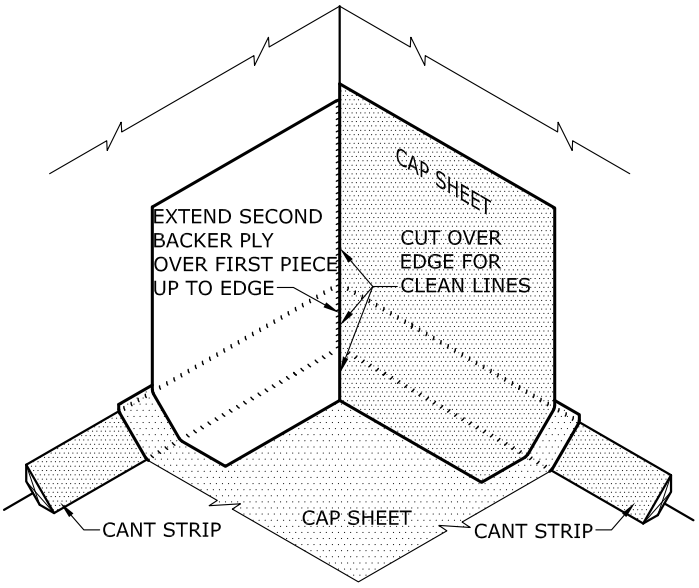
STEP 1



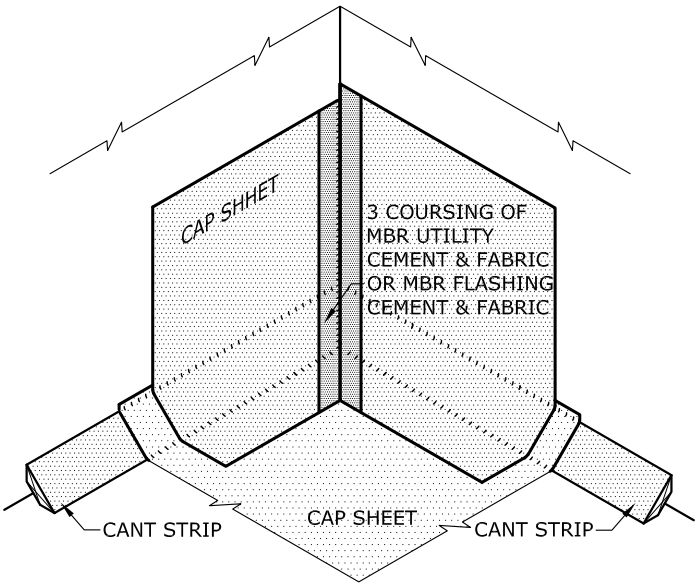
STEP 2



STEP 3



STEP 4



NOTES:

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2. 3-COURSING WITH MBR UTILITY CEMENT & FABRIC OR MBR FLASHING CEMENT & FABRIC MUST BE USED ALONG EDGE OF BASE FLASHING AS DEPICTED IN STEP 4.
3. VERTICAL JOINTS ARE TO BE OVERLAPPED 4" MINIMUM FOR ALL APPLICATIONS. 3 COURSING WITH MBR UTILITY CEMENT AND FABRIC OR JM MBR FLASHING CEMENT IS RECOMMENDED ON ALL VERTICAL FLASHING LAPS AND INSIDE/OUTSIDE CORNERS EXTENDING PAST LEADING EDGE OF CANT STRIP.
4. PLEASE SEE BITUMINOUS FLASHING SPECIFICATIONS FOR A FULL DESCRIPTION OF INSTALLATION INSTRUCTIONS AND REQUIREMENTS WHICH ARE CONSIDERED A PART OF THIS DETAIL.
5. JM POLYESTER REINFORCED BACKER PLY INCLUDES DYNABASE PR OR DYNALASTIC 180 S.
6. MASONRY SUBSTRATES REQUIRE PRIMING WITH ASPHALT PRIMER PRIOR TO BACKER PLY INSTALLATION. WOOD SUBSTRATES REQUIRE A MECHANICALLY FASTENED BACKER PLY FASTENED 9" O.C. IN BOTH DIRECTIONS.

DRAWING NO.

BIT-27

CURB & CORNER

BASE FLASHING AT INSIDE CORNER

MEMBRANE TYPE:
BUR

SCALE
N.T.S

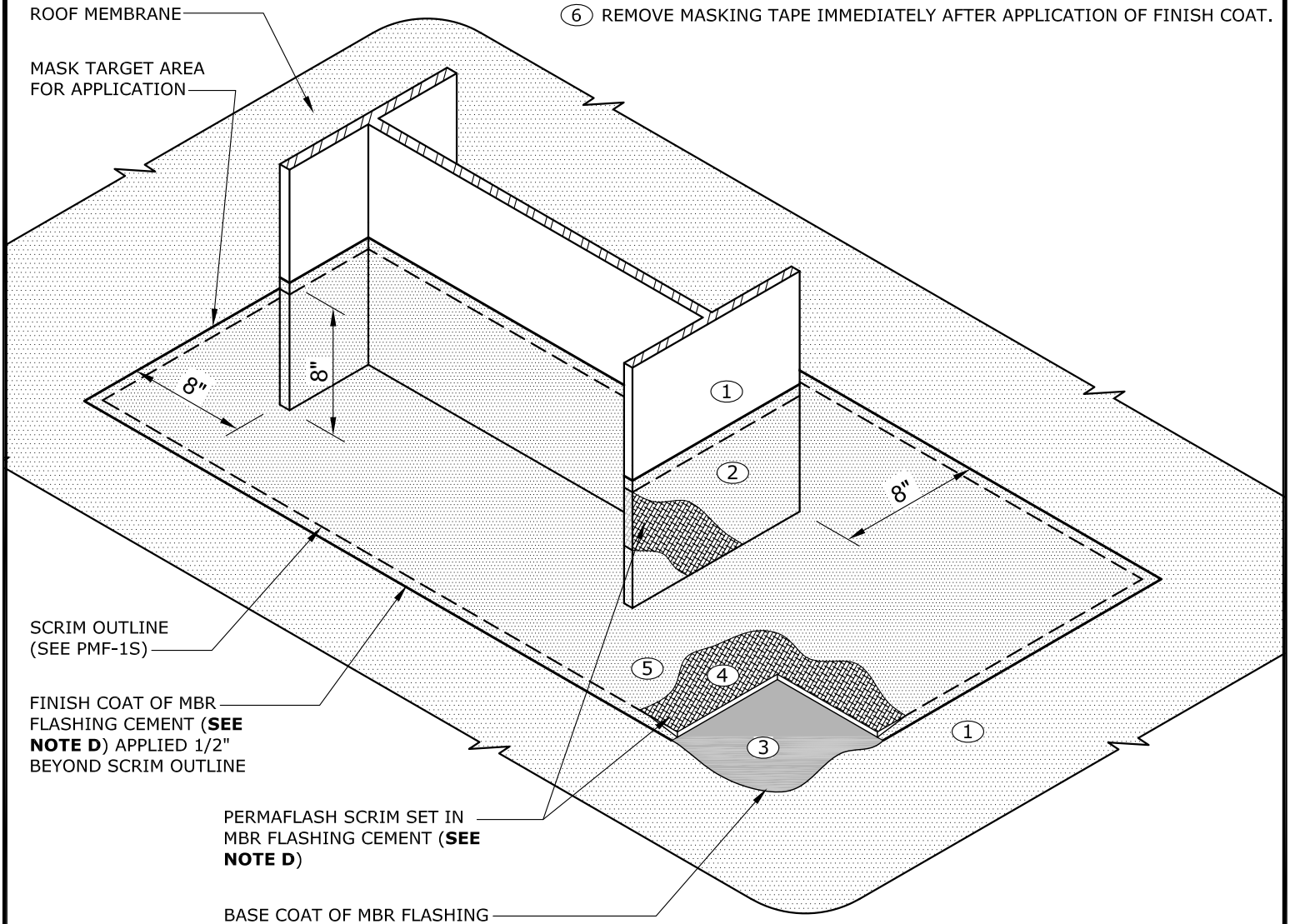
ISSUE DATE
02-06-19

MAXIMUM GUARANTEE TERM:

Johns Manville

ASSEMBLY

1. MASK TARGET AREA ON ROOF MEMBRANE AND PENETRATION.
2. CLEAN & PRIME ALL NON-POROUS AREAS (METAL, ETC.) REQUIRING LIQUID MEMBRANE WITH PERMAFLASH PRIMER.
3. APPLY 30 MIL. BASE COAT OF MBR FLASHING CEMENT (**SEE NOTE D**) WITHIN TARGET AREA. (A BRUSH WORKS BEST).
4. EMBED SCRIM(S) INTO WET BASE COAT OF MBR FLASHING CEMENT (**SEE NOTE D**), 1/2" SHORT OF TARGET AREA.
5. IMMEDIATELY AFTER EMBEDDING THE SCRIM, APPLY 60 MIL. FINISH COAT OF MBR FLASHING CEMENT (**SEE NOTE D**) OVER SCRIM AND 1/2" BEYOND, ENSURING SCRIM IS COMPLETELY EMBEDDED.
6. REMOVE MASKING TAPE IMMEDIATELY AFTER APPLICATION OF FINISH COAT.



NOTES:

A. USE THIS DETAIL IN CONJUNCTION WITH THE PERMAFLASH I-BEAM SCRIM LAYOUT, DRAWING PMF-1S.

B. ENSURE TOTAL TARGET AREA OF FLASHING IS NO LESS THAN 16" x 16".

C. AN EXTRA COAT OF MBR FLASHING CEMENT OR **1-PART PERMAFLASH®** MUST BE PLACED BETWEEN SCRIM LAYERS WHERE THEY OVERLAP TO ENSURE A PROPER BOND.

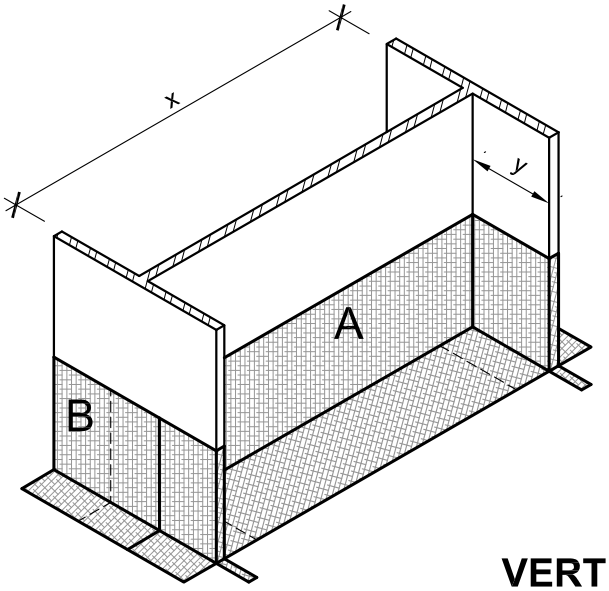
D. **1-PART PERMAFLASH® IS A SUITABLE ALTERNATIVE TO MBR FLASHING CEMENT.**

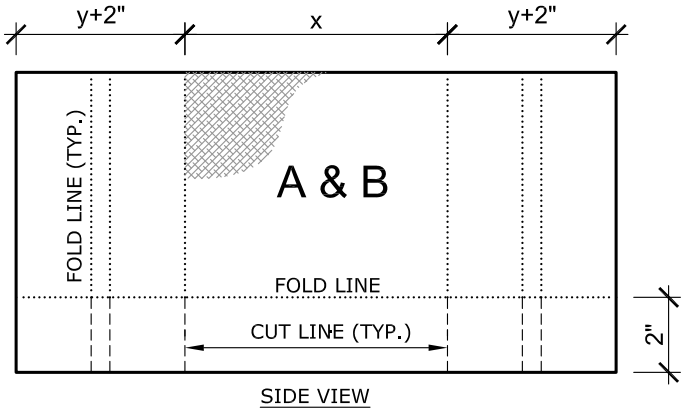
E. REFER TO PERMAFLASH APPLICATION INSTRUCTIONS FOR GENERAL GUIDELINES REGARDING THE PERMAFLASH SYSTEM.

F. AN OPTIONAL SURFACING OF JM COATING MAY BE APPLIED AFTER THE PERMAFLASH HAS CURED OR GRANULES BROADCAST INTO THE WET CEMENT.

DRAWING NO.	PERMAFLASH I-BEAM DETAIL	
PMF-1 PENETRATION	MEMBRANE TYPE: PERMAFLASH	Johns Manville is a manufacturer of commercial roofing products and offers this general conceptual information to you as a courtesy for general educational purposes only. This complimentary assistance is not to be either used or relied upon by anyone as a substitute for professional engineering design and documentation required by any building code, contract, or applicable law. By accepting the general conceptual information, you agree it does not constitute any representations, endorsements of, or an assumption by Johns Manville of any duty or liability for either the adequacy of the design of a building, any of its components or the sufficiency of any construction.
SCALE N.T.S / ISSUE DATE 09-25-23	MAXIMUM GUARANTEE TERM:	

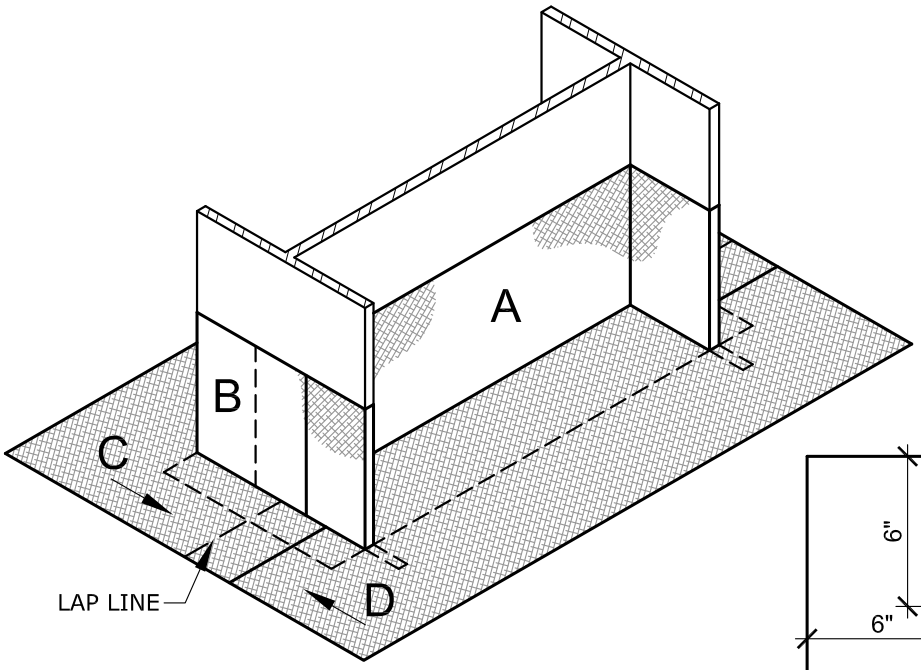
Johns Manville

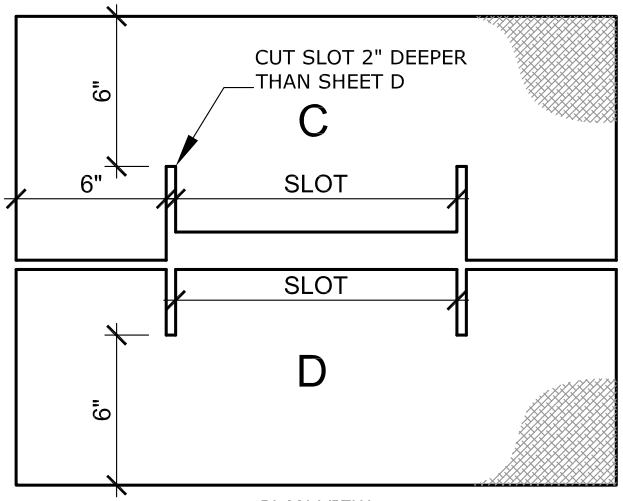




SIDE VIEW

VERTICAL SURFACES
STEPS A & B





PLAN VIEW

NOTES:

A. USE SCRIM LAYOUT IN CONJUNCTION WITH THE PERMAFLASH I-BEAM DETAIL DRAWING, PMF-1.

B. ALL FOLD LINES SHOWN AS, ····· ALL CUT LINES SHOWN AS – – – – –

C. AN EXTRA COAT OF MBR FLASHING CEMENT OR **1-PART PERMAFLASH®** MUST BE PLACED BETWEEN SCRIM LAYERS WHERE THEY OVERLAP TO ENSURE A PROPER BOND.

HORIZONTAL SURFACES
STEPS C & D

DRAWING NO.
PMF-1S
PENETRATION

PERMAFLASH I-BEAM SCRIM LAYOUT

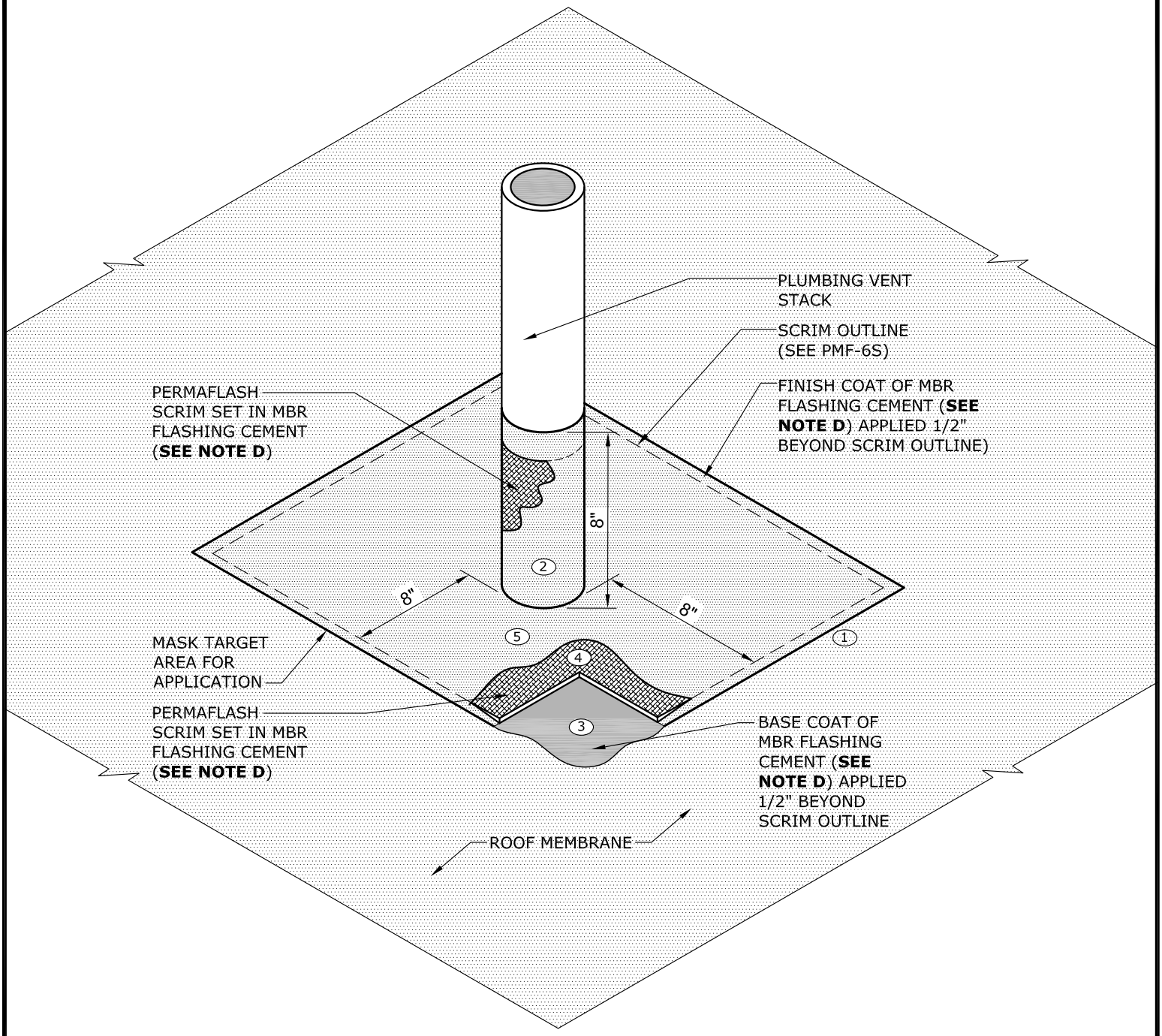
MEMBRANE TYPE:
PERMAFLASH

SCALE
N.T.S

ISSUE DATE
09-25-23

MAXIMUM GUARANTEE TERM:

Johns Manville



NOTES:

A. USE THIS DETAIL IN CONJUNCTION WITH THE PERMAFLASH PIPE PENETRATION SCRIM LAYOUT, DRAWING PMF-6S.

B. ENSURE TOTAL TARGET AREA OF FLASHING IS NO LESS THAN 16" x 16".

C. AN EXTRA COAT OF MBR FLASHING CEMENT OR **1-PART PERMAFLASH®** MUST BE PLACED BETWEEN SCRIM LAYERS WHERE THEY OVERLAP TO ENSURE A PROPER BOND.

D. **1-PART PERMAFLASH® IS A SUITABLE ALTERNATIVE TO MBR FLASHING CEMENT.**

D. REFER TO PERMAFLASH APPLICATION INSTRUCTIONS FOR GENERAL GUIDELINES REGARDING THE PERMAFLASH SYSTEM.

E. AN OPTIONAL SURFACING OF JM COATING MAY BE APPLIED AFTER THE PERMAFLASH HAS CURED OR GRANULES BROADCAST INTO THE WET CEMENT.

ASSEMBLY

(1) MASK TARGET AREA ON ROOF MEMBRANE AND PENETRATION.

(2) CLEAN & PRIME ALL NON-POROUS AREAS (METAL, ETC.) REQUIRING LIQUID MEMBRANE WITH PERMAFLASH PRIMER.

(3) APPLY 30 MIL. BASE COAT OF MBR FLASHING CEMENT (**SEE NOTE D**) WITHIN TARGET AREA. (A BRUSH WORKS BEST).

(4) EMBED SCRIM(S) INTO WET BASE COAT OF MBR FLASHING CEMENT (**SEE NOTE D**), 1/2" SHORT OF TARGET AREA.

(5) IMMEDIATELY AFTER EMBEDDING THE SCRIM, APPLY 60 MIL. FINISH COAT OF MBR FLASHING CEMENT (**SEE NOTE D**) OVER SCRIM AND 1/2" BEYOND, ENSURING SCRIM IS COMPLETELY EMBEDDED.

(6) REMOVE MASKING TAPE IMMEDIATELY AFTER APPLICATION OF FINISH COAT.

DRAWING NO.
PMF-6
PENETRATION

PERMAFLASH PIPE PENETRATION DETAIL

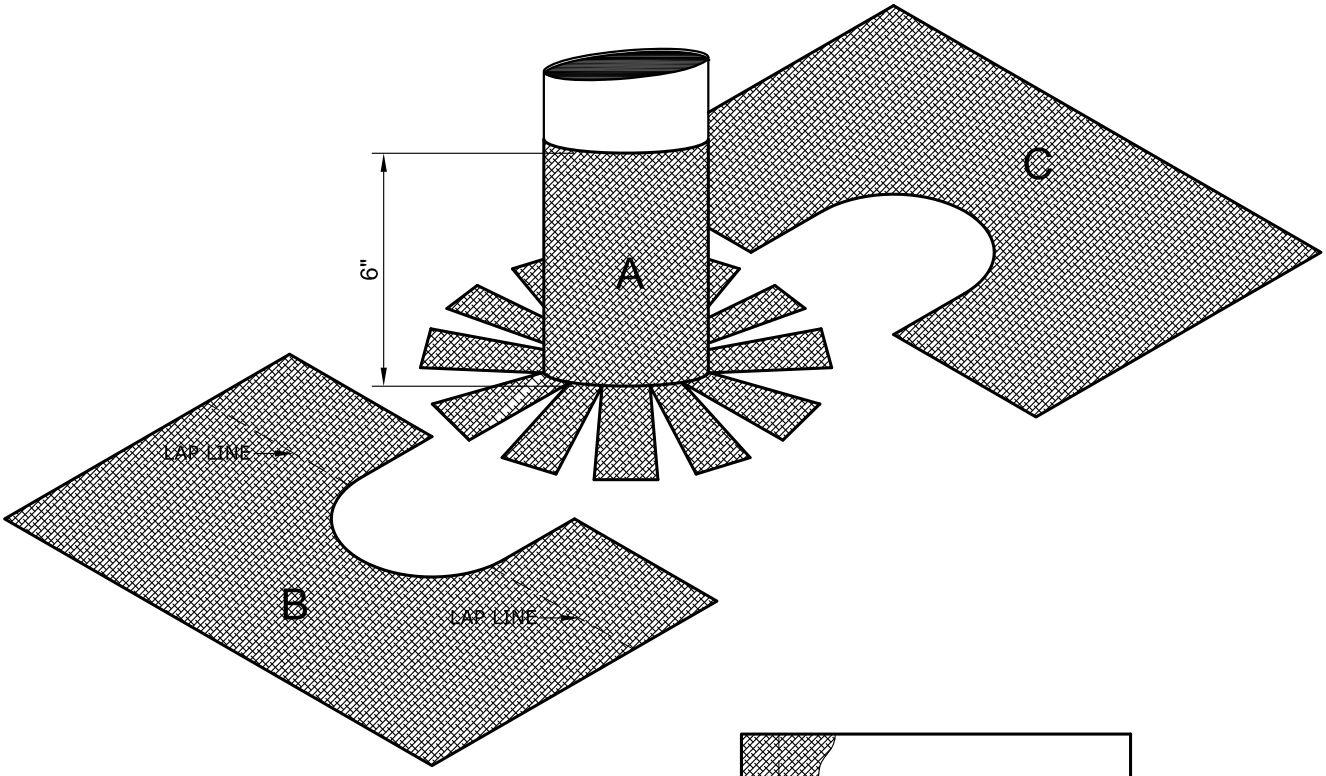
MEMBRANE TYPE:
PERMAFLASH

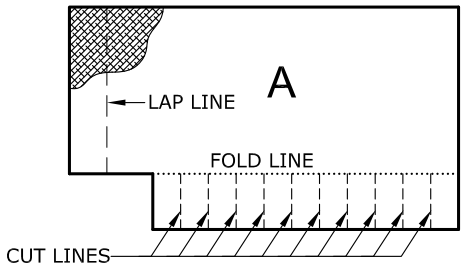
SCALE
N.T.S

ISSUE DATE
09-25-23

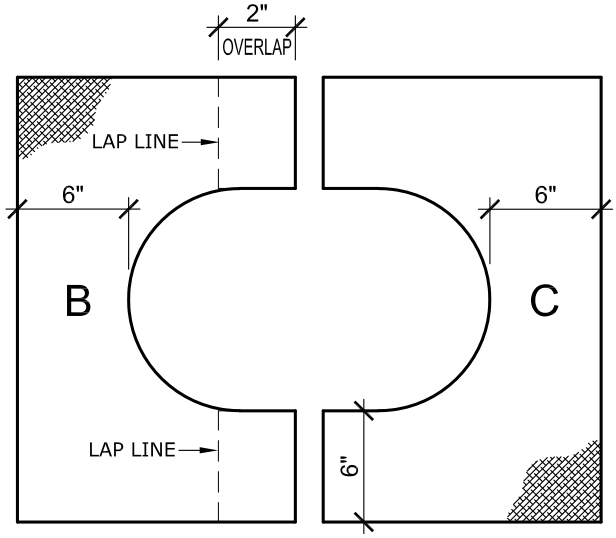
MAXIMUM GUARANTEE TERM:

Johns Manville





A FINGER CUTS
STEP A



B & C TARGET REINFORCEMENT
STEP B & C

NOTES:

A. USE SCRIM DETAIL IN CONJUNCTION WITH THE PERMAFLASH PIPE PENETRATION DETAIL DRAWING, PMF-6.

B. ALL FOLD LINES REPRESENTED AS ..... ALL CUT LINES REPRESENTED AS - - - - - -

C. AN EXTRA COAT OF MBR FLASHING CEMENT MUST BE PLACED BETWEEN SCRIM LAYERS WHERE THEY OVERLAP TO ENSURE A PROPER BOND.

DRAWING NO.
PMF-6S
PENETRATION

PERMAFLASH PIPE PENETRATION SCRIM LAYOUT

MEMBRANE TYPE:
PERMAFLASH

SCALE
N.T.S

ISSUE DATE
12-15-20

MAXIMUM GUARANTEE TERM:

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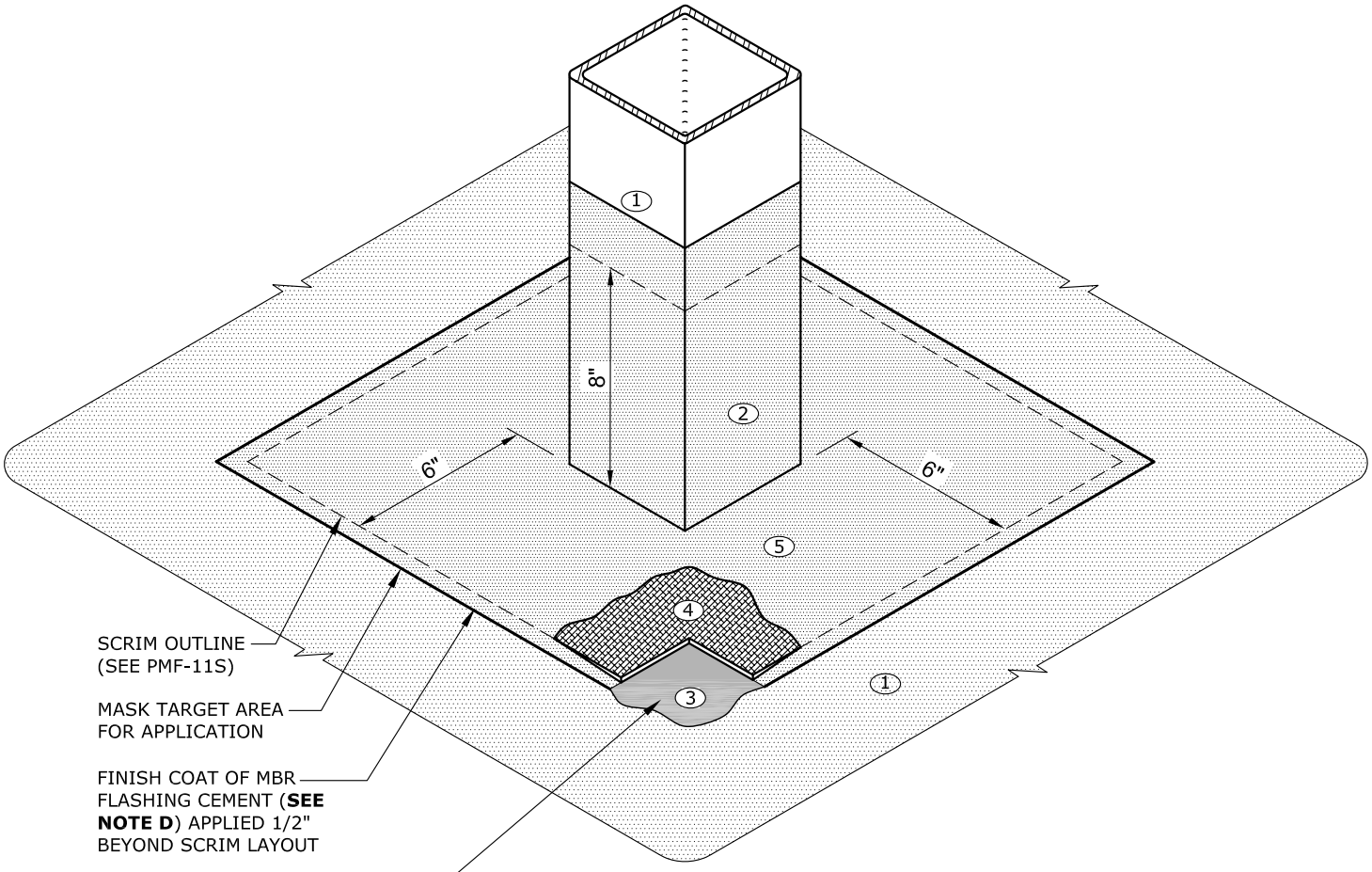


NOTES:

A. USE THIS DETAIL IN CONJUNCTION WITH THE PERMAFLASH SQUARE METAL TUBE SCRIM LAYOUT, DRAWING PMF-11S.

B. ENSURE TOTAL TARGET AREA OF FLASHING IS NO LESS THAN 16" x 16".

C. AN EXTRA COAT OF MBR FLASHING CEMENT OR **1-PART PERMAFLASH®** MUST BE PLACED BETWEEN SCRIM LAYERS WHERE THEY OVERLAP TO ENSURE A PROPER BOND.

D. **1-PART PERMAFLASH® IS A SUITABLE ALTERNATIVE TO MBR FLASHING CEMENT.**

E. REFER TO PERMAFLASH APPLICATION INSTRUCTIONS FOR GENERAL GUIDELINES REGARDING THE PERMAFLASH SYSTEM.

F. AN OPTIONAL SURFACING OF JM COATING MAY BE APPLIED AFTER THE PERMAFLASH HAS CURED OR GRANULES BROADCAST INTO THE WET CEMENT.

ASSEMBLY

(1) MASK TARGET AREA ON ROOF MEMBRANE AND PENETRATION.

(2) CLEAN & PRIME ALL NON-POROUS AREAS (METAL, ETC.) REQUIRING LIQUID MEMBRANE WITH PERMAFLASH PRIMER.

(3) APPLY 30 MIL. BASE COAT OF MBR FLASHING CEMENT (**SEE NOTE D**) WITHIN TARGET AREA. (A BRUSH WORKS BEST).

(4) EMBED SCRIM(S) INTO WET BASE COAT OF MBR FLASHING CEMENT (**SEE NOTE D**), 1/2" SHORT OF TARGET AREA.

(5) IMMEDIATELY AFTER EMBEDDING THE SCRIM, APPLY 60 MIL. FINISH COAT OF MBR FLASHING CEMENT (**SEE NOTE D**) OVER SCRIM AND 1/2" BEYOND, ENSURING SCRIM IS COMPLETELY EMBEDDED.

(6) REMOVE MASKING TAPE IMMEDIATELY AFTER APPLICATION OF FINISH COAT.

DRAWING NO.
PMF-11
PENETRATION

PERMAFLASH SQUARE METAL TUBE DETAIL

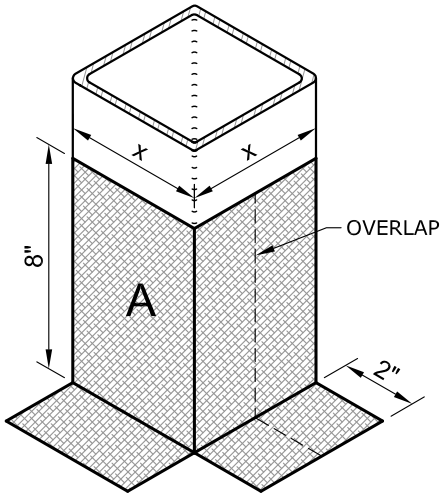
MEMBRANE TYPE:
PERMAFLASH

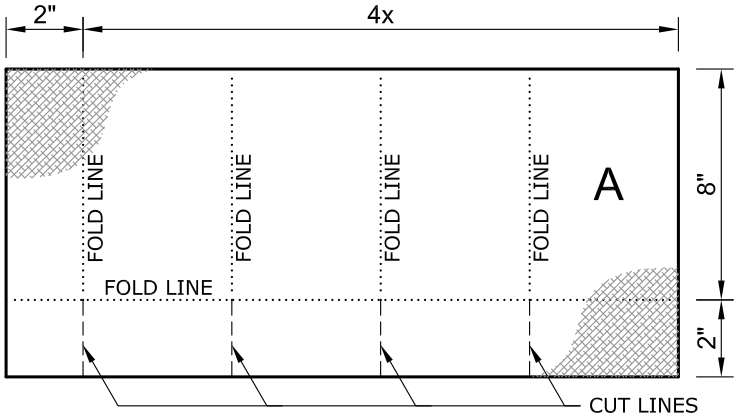
SCALE
N.T.S

ISSUE DATE
09-25-23

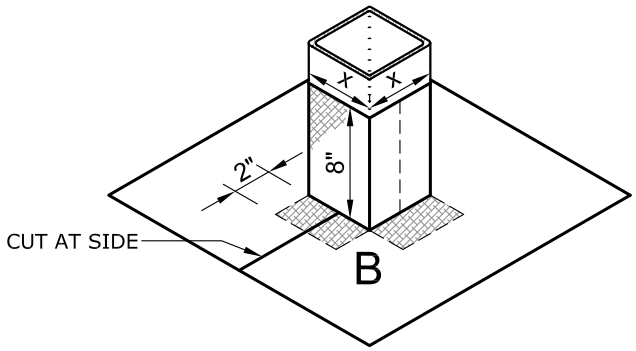
MAXIMUM GUARANTEE TERM:

Johns Manville

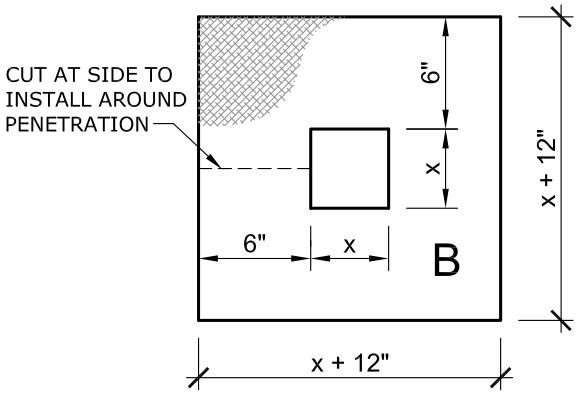




A VERTICAL SURFACES
STEP A



HALF SCALE



B HORIZONTAL SURFACE
STEP B

NOTES:

A. USE SCRIM LAYOUT IN CONJUNCTION WITH THE PERMAFLASH SQUARE METAL TUBE DETAIL DRAWING, PMF-11.

B. ALL FOLD LINES REPRESENTED AS ..... ALL CUT LINES REPRESENTED AS – – – – –

C. AN EXTRA COAT OF MBR FLASHING CEMENT OR **1-PART PERMAFLASH®** MUST BE PLACED BETWEEN SCRIM LAYERS WHERE THEY OVERLAP TO ENSURE A PROPER BOND.

DRAWING NO. **PMF-11S** PENETRATION	# PERMAFLASH SQUARE METAL TUBE SCRIM DETAIL	
	MEMBRANE TYPE: PERMAFLASH	Johns Manville is a manufacturer of commercial roofing products and offers this general conceptual information to you as a courtesy for general educational purposes only. This complimentary assistance is not to be either used or relied upon by anyone as a substitute for professional engineering design and documentation required by any building code, contract, or applicable law. By accepting the general conceptual information, you agree it does not constitute any representations, endorsements of, or an assumption by Johns Manville of any duty or liability for either the adequacy of the design of a building, any of its components or the sufficiency of any construction.
SCALE N.T.S / ISSUE DATE 12-15-20	MAXIMUM GUARANTEE TERM:	

Johns Manville

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Roof penetration sleeves and bonnets.
2. Receivers.
3. Counter flashings.
4. Sanitary vent pipes.
5. Curb cap flashings.
6. Exhaust vents.
7. Copings.
8. Drip edge.
9. Gutters and downspouts.
10. Miscellaneous sheet metal accessories.

B. Related Sections include the following:

1. Division 07 Section “Standing Seam Metal Roof Panels”.
2. Division 07 Section “SBS Modified Bituminous Membrane Roofing”.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

B. National Roofing Contractor’s Association (NRCA): NRCA Roofing and Waterproofing Manual, latest edition.

C. Sheet Metal and Air Conditioning Contractor’s National Association, Inc. (SMACNA): Architectural Sheet Metal Manual, latest edition.

D. ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

1.04 WARRANTY

A. Contractor's Warranty: Provide Owner a written warranty which shall warrant sheet metal work to be free of leaks and defects in materials and workmanship for two years after date of final acceptance by owner.

B. For pre-finished metal, provide manufacturer's twenty-year guarantee covering deterioration or failure of the flouropolymer finish.

1.05 PERFORMANCE REQUIREMENTS

A. Fabricate and install sheet metal edge flashings to comply with ANSI/SPRI ES-1 requirements.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER'S

A. Accessory sheet metal components of the roofing system shall be supplied by the prime roof manufacturer. Alternate manufacturers shall not be permitted unless pre-approved in writing by the prime roof manufacturer.

2.02 SHEET METAL MATERIAL

A. Pre-finished Metal: "Kynar 500" or "Hylar 5000" flouropolymer pre-finished G90 galvanized/galvalume sheet metal, minimum 24-gauge. "Kynar 500" or "Hylar 5000" finish shall consist of a two-coat Polyvinyladine fluoride, minimum 70% by weight in coatings, dry film thickness 1 mil, factory applied by metal manufacturer or supplier. Color to be selected by Owner and Architect from manufacturer's standard color chart.

B. Zinc-coated (Galvanized) Sheet Metal: Commercial Quality with 0.20% copper, in accordance with ASTM A 526 except ASTM A 527 for lock forming; coating designation G() hot-dip galvanized, and mill phosphatized for painting in accordance with ASTM A 525 (paint-grip type), 22-gauge minimum.

C. Sheet Lead: FS QQ-L-201, Grade B; 2-1/2-pounds per square', 0.0391"-thick minimum used for sanitary vent flashing; 4-pounds per square' (140n/m2) 0.0625" (1.6mm) thick minimum as used for roof drains

D. Stainless-steel Sheet Metal: ASTM A240, Type 304, ASTM A480, No. 2B/2D Mill Finish,-gauge as scheduled.

2.03 FASTENERS

A. Fasteners shall be same metal as flashing and sheet metal being joined.

B. Exposed fasteners shall be self-sealing or gasketed for watertight installation.

C. Heads of fasteners, including but not limited to, rivets, screws, and bolts, that are exposed or visible shall have same manufactured finishes as item being secured; color to match when applicable.

D. Mechanical Fasteners:

1. Washers: Steel washers with bonded rubber sealing gasket.
2. Screws: Self-tapping sheet metal type compatible with material fastened.
3. Rivets: Stainless-steel material for the stem with closed end, head of color to match sheet metal items being adjoined.

2.04 RELATED MATERIALS

A. Solder:

1. ASTM B 32, alloy grade 58, 50% tin, 50% lead.
2. For Use with Stainless-steel: 60-40 tin/lead solder, ASTM B 32.

B. Flux:

1. Phosphoric acid type, manufacturer's standard.
2. For Use with Steel or Copper: Rosin flux.
3. For Use with Stainless-steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.

C. Underlayment: As specified in Division 7 Section “Standing Seam Metal Roof Panels”.

D. Adhesives: Type recommended by flashing sheet manufacturer for waterproof and weather resistant seaming and adhesive application of flashing sheet.

E. Metal Accessories: Sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and-gauge required for performance.

F. Termination Bar: 1/8” (3mm) thick, 1” (25mm) wide extruded aluminum bar with flat profile, factory punched oval holes (1/4” by 3/8” [6mm by 9mm]) spaced 6” (150mm) on-center, such as "TB 125" by The TruFast Corp. or “Heavy Flat Bar” by OMG.

2.05 FABRICATION – GENERAL

A. Fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and approved shop drawings.

B. Comply with material manufacturer's instructions and recommendations for forming material.

C. Shop fabricate work to greatest extent possible. Fabricate inside and outside corners for metal edge flashings and copings from single piece with equal length legs, minimum 3'. Notch, lap, and seam inside and outside corners of counter flashings.

D. Fabricate for waterproof and weather resistant performance with expansion provisions for running work sufficient to permanently prevent leakage, damage, or deterioration of work. Form work to fit substrates.

E. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling.

F. Form materials with straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.

G. Fold back edges of exposed ends of sheet metal edge to form hem, 6" minimum.

H. Lap joints 1" (25mm) minimum. Rivet and solder joints on parts that are to be permanently and rigidly assembled for copper, stainless, aluminum, and galvanized sheet metal. Install rivets, spaced 1" (25mm) on-center and apply solder to secure and seal exposed edge of sheet metal in a uniform continuous bead with smooth top finish. Clean residue upon completion of soldering process. Fabricate sheet metal assemblies so that adjoining sections are nested to achieve continuous metal-to-metal contact.

I. Seams:

1. Fabricate non-moving seams in sheet metal with flat-lock seams.
2. Pre-finished Galvanized Sheet metal: Seal pre-finished metal seams with rivets, spaced 1" (25mm) on-center, and silicone sealant, color to match metal finish.
3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.

J. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1"-deep, filled with sealant concealed within joints.

2.06 FABRICATED ITEMS

A. Receivers & Counter flashings: Minimum 24-gauge prefinished or stainless-steel sheet metal formed in maximum 10' (3m) lengths; fabricate "S"-shaped receiver to engage counter flashing a minimum of 1"; fabricate counter flashing with broken fascia of length to extend over top edge of base flashing a minimum of 4" with ó" hemmed drip edge.

B. Wind Clips: Minimum 24-gauge stainless-steel or prefinished sheet metal, 1" (25mm) wide, length to engage counter flashing a minimum of 1/2" (13mm).

C. Roof Penetration Flashing Pan and Bonnet: Minimum 24-gauge stainless-steel sheet metal. Fabricate pan with 1/4" (6mm) hem at top edge, 4" (100mm) wide horizontal flanges with rounded corners; to provide installed minimum clear inside perimeter dimension of 2" (50mm)

on each side of penetrating element and 6” height. Fabricate bonnet in two-piece adjustable construction with ó” caulk trough along top edge and a skirt, with hemmed edge, of length to extend over top edge of pan a minimum of 2” (50mm).

D. Expansion Joint Cover: 24-gauge stainless-steel sheet metal with 1” high standing seam at joints.

E. Cleats/Clips:

1. Concealed Cleats/Clips: Continuous strips, 22-gauge sheet metal, same metal type and fascia profile as adjacent metal item, with a 3/4” drip edge formed at a 30° angle with vertical wall.
2. Exposed Cleats/Clips: 24-gauge prefinished or stainless-steel sheet metal.

F. Angle Termination Bar: 1” by 1” (25mm by 25mm) 24-gauge galvanized sheet metal.

G. Sanitary/Plumbing Vent Pipe: 2-1/2-pound lead preformed flashing sleeve with 4” flanges and of proper size/height to fold down inside of vent pipe a minimum of 1” (25mm).

H. Roof Drain: 4-pound lead sheet, size 30” by 30” (750mm by 750mm).

I. Pipe Box (Base, Hood, and Face Plate): 24-gauge stainless-steel sheet metal. Base shall be 8” in height, with 4”-wide flanges with rounded corners, and sized to provide minimum 2” clearance between pipes and box.

J. Coping: 24-gauge pre-finished sheet metal with 6” (150mm) wide cover plates of same profile. Form 3/4” drips with 5/8” returns at 30-degree angle with vertical wall at bottom end of both interior and exterior fascias.

K. Drip Edge: 24-gauge pre-finished sheet metal with 6”-wide cover plates of same material/profile. Form 3/4” drips with 5/8” returns at 30° angle with vertical wall at bottom end of both interior and exterior fascias.

L. Gutters and Downspouts: 24-gauge pre-finished sheet metal with straps of the same material/profile.

M. Scupper: Minimum 24-gauge stainless-steel sheet metal with prefinished face plate.

N. Collector Head: 24-gauge pre-finished sheet metal 2”-wider than scupper opening in each direction; with tapered bottom to 4” X 4” downspouts. Provide overflow port in the side of collector head.

O. Curb Cap Flashing: 24-gauge stainless-steel sheet metal with 4” vertical fascias.

P. Goose-neck Vent: 24-gauge stainless-steel sheet metal. Base shall be 8” in height with 4”-wide horizontal flanges with rounded corners.

Q. Blocking and nailers: Provide all pressure treated (fire retardant where required) wood blocking and nailers as required for securely fastening all metal trim and accessories

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrates are smooth and clean to extent needed for sheet metal work.

B. Verify that reglets, nails, cants, and blocking to receive sheet metal are installed and free of debris.

C. Do not start sheet metal work until conditions are satisfactory.

3.02 INSTALLATION

A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4" hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Install prefabricated corners or transitions at changes in direction, elevation, or plane, and at intersections. Locate field joints not less than 12", not more than 3' from actual corner. Laps for all metals, except for prefinished metal, shall be 1"-wide, fastened with rivets spaced 1" on-center and soldered.

B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners where possible; and set units true to line and level as indicated. Install work with laps, joints, and seams permanently watertight and weatherproof.

C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.

D. Prime all flanged sheet metal and allow to dry completely. Set in a liberal bed of SBS modified mastic and strip in to achieve a full finished two plies of SBS modified roofing membrane.

E. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating affected surfaces with zinc chromate or other permanent liquid-applied or sheet product separation at locations of contact.

F. Continuous Cleat: At exposed edges of metal edge flashings, fascias, copings, and where required, attach continuous cleat at 6" on-center with appropriate fasteners metal or steel substrate. At 10' from each direction of corner, install fasteners spaced 3" on-center. Install cleat so fascia extends a minimum of 1" below top of exterior wall finish.

G. Counter flashings:

1. Install counter flashings under equipment housing flanges and receivers along rise or parapet walls to extend a minimum of 4" below top edge of base flashing.

2. Secure counter flashing at 6" on-center with self-tapping screws.

3. Saw-cut reglet mounted assemblies: Saw cut new joint, 1/2" X 1"-deep, in masonry/concrete where required and to install new receiver. Clean and prepare joint surfaces to receive sealant and insert receiver into joint. Secure new receiver in place with lead wedges spaced 12" on-center wedged into joint. Install backer rod into saw-cut reglet

and apply a continuous bead of sealant along reglet and top edge of receiver and tool sealant to provide outward sloping finished surface. Secure counter flashing to receiver utilizing self-tapping grommetted screws spaced 6" on-center.

4. Surface-mounted assemblies: Secure 2-piece surface-mounted receiver and counter flashing assemblies along substrates. Install sealant tape between receiver and substrate. Secure receiver to substrate with termination bar and appropriate fasteners spaced 12" o.c. Install a continuous bead of sealant along caulk trough/top edge of receiver and tool sealant to provide outward sloping finished surface. Secure counter flashing to receiver utilizing grommetted self-tapping screws spaced 6" on-center.
5. Install receivers extending behind wall finish and secure vertical flange of receiver 6- inches on-center to back-up wall or metal wall panels. Extend underlayment and/or dampproofing material over vertical flange of receiver, where applicable.
6. Lap adjacent sections of receivers and counter flashings a minimum of 4". Apply a continuous bead of sealant in lap.
7. Secure counter flashing to equipment flanges utilizing self-tapping screws spaced 6" on-center.
8. Install wind clips to termination bar spaced 24" on-center and engage drip edge of counter flashing a minimum of 1/2".
9. Fabricate the counter flashing to form an integral closure at terminations.

H. Penetration Pans:

1. Install compressible fill insulation between penetrating element and deck.
2. Prime tops and bottoms of flanges of penetration pans.
3. Pop rivet and fully solder joints in pan and flanges.
4. Install penetration pan with flanges set in a uniform troweling of modified bitumen mastic on SBS membrane base ply, secure flange with appropriate fasteners spaced 6" on-center, staggered, and strip-in flanges.
5. Fill penetration pan to within 1" (25mm) of top of pan with non-shrink grout. Clean surfaces of pan and penetrating element and fill remainder of pan with pourable sealer.
6. Install sheet metal bonnet or hood to conceal the top of the penetration pan.

I. Roof Penetration Hoods and Bonnet:

1. Install sheet metal hood or bonnet on penetrating element to cover the top of the penetration pans.
2. Round or Pipe Penetrations:
    a. Set bonnet in sealant.
    b. Install stainless-steel draw-band and tighten to secure to penetration.

c. Seal top of bonnet with sealant.

3. Square Penetration:

a. Secure bonnet to penetration with termination bar and self-drilling screws.

b. Set bonnet in sealant.

c. Seal top of bonnet with sealant.

J. Pipe Box:

1. Pop rivet and fully solder joints and seams in sheet metal base and hood.
2. Prime top and bottom of flanges of base.
3. Install penetration pan with flanges set in a uniform troweling of modified bitumen mastic on SBS membrane base ply, secure flange with appropriate fasteners spaced 6” on-center, staggered, and strip-in flanges.
4. Fill base with grout or spray foam to a height of 3/4 of the total pan height.
5. Fill remaining height of base with pourable sealer.
6. Install hood over base, securing to each side with self-tapping screws, and sloping down toward front of box.
7. Install face plate to cover box opening around pipe penetrations and apply sealant around pipe configuration at face plate.

K. Sanitary/Plumbing Vent Pipes:

1. Prime top and bottom flanges of lead flashing sleeve. Set flange or embed in uniform troweling of modified bitumen mastic on SBS membrane base ply. Prime top side of flange to receive strip-in membrane.
2. Fold lead sleeve down inside pipe a minimum of 1”. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve. Paint exposed lead flashing with elastomeric coating to match color of membrane top ply.

3.03 CLEANING

A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean and free of stains, scrap, and debris.

B. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration/damage of finishes. Paint (color to match) areas of prefinished metal where finish is damaged. Replace sheet metal items when damaged finish cannot be repaired to an acceptable condition.

C. Prime soldered area of phosphatized metal after cleaning to prevent rusting.

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including general and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Firestopping in fire-rated assemblies.

1.03 RELATED WORK

A. Section 09 20 00 – Gypsum wall board, metal frames system.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E 119 – Test Methods for Fire Tests of Building Construction and Materials.
2. ASTM E 814 – Test Methods for Fire Tests of Through Penetration Fire Stops.

B. Underwriters' Laboratories, Inc. (UL):

1. UL 1479 – Fire Tests of Through-Penetration Firestops.

1.03 DEFINITIONS

A. Firestopping: Sealing material or assembly placed in spaces between building materials to stop movement of smoke, heat, gasses, or fire through openings.

1.04 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E 119, ASTM E 814, UL 1479 to achieve a fire rating as indicated on Drawings.

1.05 SUBMITTALS

A. Submittal Procedures under Section 01 33 00.

1. Product Data: Product characteristics, performance, and limitation criteria.
2. Assurance/Control Submittals:

a. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
b. Qualification Documentation: Firestopping installer documentation of experience indicating compliance with specified qualification requirements.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of this Section with minimum five years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver Products in manufacturer's original unopened containers or packages with labels intact, identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions, where applicable.

B. Store and handle materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.08 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements:

1. Do not install materials when temperature of substrate material and ambient air is below 60 degrees F.
2. Maintain minimum temperature before, during, and for 3 days after installation of materials.
3. Keep away from heat, open flame, sparks, or other sources of ignition until curing is complete. Use only with adequate ventilation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturer's offering firestopping materials which may be incorporated in the work include the following:

1. Nelson Firestop Products, Tulsa, OK (800) 331-7325.
2. Hilti Firestop Systems, Tulsa, OK (800) 879-8000.
3. The Rectorseal Corporation, Houston, TX (800) 231-3345.
4. Specified Technologies, Incorporated (STI), Somerville, NJ (800) 992-1180.
5. 3M Fire Protection Products, St. Paul, MN (800) 328-1687.
6. Tremco Firestop System, Beechwood, OH (800) 321-7906.

B. Substitutions: Under Section 01 60 00.

2.02 MATERIALS

A. Intumescent Latex Sealant: Single-component, intumescent, latex formulation.

1. LBC, by Nelson Firestop Products.
2. FS611A, by Hilti.
3. Metacaulk 950 or 1000, by RectorSeal.
4. SpecSeal SSS100, by STI.
5. CP 25WB+, by 3M.
6. TREMstop WBM, by Tremco.

B. Intumescent Solvent-Release-Curing Sealant: Single component, intumescent, synthetic-polymer based, non-sag grade.

1. CP 25N/S, by 3M.
2. TREMstop WBM, by Tremco.

C. Intumescent Wrap/Strip: Single-component, elastomeric sheet with aluminum foil on one face.

1. WRS, by Nelson Firestop Products.
2. Metacaulk Wrap Strip, by RectorSeal.
3. SpecSeal SSWRED Wrapstrip, by STI.
4. FS-195+ Wrap/Strip, by 3M.
5. TREMstop WS, by Tremco.

D. Intumescent Putty: Single-component, non-hardening, dielectric, intumescent putty.

1. FSP, by Nelson Firestop Products.
2. Metacaulk Fire Rated Putty, by RectorSeal.
3. SpecSeal Putty, by STI.
4. Moldable Putty+, by 3M.

E. Silicone Sealant: Single-component, moisture-curing, silicone-based elastomeric, non-sag grade.

1. CLK N/S, by Nelson Firestop Products.
2. FS 601, by Hilti.
3. Metacaulk 835, by RectorSeal.
4. SpecSeal PEN 300, by STI.
5. 2000+ Silicone, by 3M.
6. FYRE SIL, by Tremco.

F. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam.

1. FS Fireblocks, by Hilti.
2. SpecSeal PEN 200, by STI.
3. 2001 Silicone RTV Foam, by 3M.

G. Intumescent Collar: Factory-fabricated, intumescent collar.

1. PCS, by Nelson Firestop Products.
2. CP 642, by Hilti.

3. Metacaulk Pipe Collar, by RectorSeal.
4. SpecSeal SSC Collars, by STI.
5. Plastic PIpe Device, by 3M.
6. TREMstop D, by Tremco.

H. Intumescent Composite Sheet or Pillows and Mortar: Intumescent sheet used to firestop large openings.

1. CPS, by Nelson Firestop Products.
2. SpecSeal SSB Pillows and SpecSeal SSM Firestop Compound, by STI.
3. CS-195+ Composite Sheet, by 3M.
4. TREMstop PS, by Tremco.

I. Packing Material: Manufacturer's standard mastic, putty, ceramic fiber blanket, or mineral wool to be used as fill or backing material for firestopping.

1. FSB or Mineral Wool, by Nelson Firestop Products.
2. Mineral Wool, by Hilti.
3. Fire Safing or Backer Rod, by RectorSeal.
4. Mineral Wool, by STI.
5. FireMaster Mastic, FireMaster Putty, or FireMaster Bulk, by 3M.
6. Cerablanket, by Tremco.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:

1. Verify that field measurements, surfaces, and conditions are as required, and ready to receive Work.
2. Report in writing to Architect conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
3. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.

B. Remove incompatible materials which may affect bond.

C. Place hangers or damming materials in penetration to hold firestopping materials where required.

3.03 INSTALLATION

A. Follow manufacturer charts for appropriate material to achieve required fire rating in various locations.

B. Install firestopping at penetrations of fire rated wall materials by sleeves, piping, ductwork, conduit, and other items in accordance with manufacturer's published instructions.

3.04 CLEANING AND PROTECTION

A. Clean excessive fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening, and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations.

C. If damage occurs, cut out and remove damaged or deteriorated firestopping and install new materials.

3.05 FIELD QUALITY CONTROL

A. Quality Control: Inspection procedures, per General Conditions.

B. Contracting Officer will inspect each firestopping installation. Do not cover firestopping installations that will be concealed by other construction until Contracting Officer inspection.

3.06 SCHEDULES

A. Provide firestopping complying with UL assemblies specified below.

Penetration	Assembly	Nelson	Hilti	RectorSeal	STI	3M	Tremco
Metal Pipe	CMU Wall 8" Thick or Less	CAJ1224 or CAJ1203	CAJ1150 or CAJ1158	CAJ1114 or CAJ1115	CAJ1079 or CAJ1217	CAJ1001 or CAJ1009	CAJ1179 or CAJ1187
	Gypsum Board Partition	WL1083 or WL1030	WL1052 or WL1054	WL1026 or WL1034	WL1049 or WL1079	WL1003 or WL1009	WL1020 or WL1051
Non-Metallic Pipe	CMU Wall 8" Thick or Less	CAJ2086	CAJ2095 or CAJ2109	CAJ2021 or WJ2025	CAJ2064 or CAJ2045	CAJ2005	CAJ2082 or FA2024
	Gypsum Board Partition	WL2071	WL2078	WL2015 or WL2104	WL2093 or WL2029	WL2002 or WL2005	WL2083 or WL2082
Cable Tray	CMU Wall 8" Thick or Less	CAJ8049 or CAJ4033	CAJ4017	CAJ8043	CAJ4020 or CAJ4029	CAJ4003 or CBJ4020	CAJ4007 or WJA4005
	Gypsum Board Partition	WL4003	WL4006	N/A	WL4005 or WL4008	WL4004	WL3043 or WL3044

Insulated Metal Pipe	CMU Wall 8" thick or Less	CAJ5008 or CAJ5059	CAJ5045	WJ5016 or CAJ5070	CAJ5021 or CAJ5029	CAJ5001 or CAJ5002	CAJ5052 or CBT5005
	Gypsum Board Partition	WL5036	WL5022 or WL5029	WL5057	WL5014 or WL5051	WL5001	WL5034
Construction Gaps	CMU Wall to Metal Deck	N/A	HW-D-0008	TRC/PV120-14	U900Z020	U900Z028	U900Z013 or U900Z014
	Gyp Bd Parti'n to Metal Deck	N/A	HW-D-0003 or HW-D-0004	HWD0014 or TRC/PV120-14	HWD1001	U400V	WHPV60.01 or U900Z014

END OF SECTION

SECTION 07 92 00
CAULKING AND SEALANT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Clean and prepare joint substrate.

B. Sealant and backing materials.

C. Caulk joints around the perimeter of all frames and similar locations in exterior walls including perimeter drywall to deck.

D. At all exterior partitions, embed the bottom plate of drywall partitions in two continuous beads of caulking.

E. Embed all metal thresholds in full bed of caulking.

F. Caulk all locations where millwork abuts adjacent surfaces.

G. Caulk the perimeter of plumbing fixtures abutting adjacent surfaces.

H. Caulk all other locations where caulking or sealant is indicated or required.

1.03 RELATED SECTIONS

A. Division 4 – Masonry

B. Section 07 62 00 – Metal Flashing and Trim.

1.04 REFERENCES

American Society for Testing and Materials (ASTM):

A. ASTM C 790 – Recommended Practices for Use of Latex Sealing Compounds.

B. ASTM C 804 – Recommended Practice for Use of Solvent-Release Type Sealants.

C. ASTM C 834 – Specification for Latex Sealing Compounds.

D. ASTM C 920 – Specification for Elastomeric Joint Sealants.

E. ASTM C 1085 – Specification for Butyl Rubber-Based Solvent Release Sealants.

F. ASTM D 1056 – Flexible Cellular Material – Sponge or Expanded Rubber.

G. ASTM D 1565 – Flexible Cellular Materials – Vinyl Chloride Polymers and Copolymers (open cell foam).

1.05 SUBMITTALS

A. Submit product data and colors per General Conditions Section 01 33 00.

1.06 DELIVERY AND STORAGE OF MATERIALS

A. As per Section 01 66 00.

B. Deliver materials in unopened containers as packaged by the manufacturer. Store in a manner to protect materials from weather.

1.07 WARRANTY

A. Written five-year warranty.

B. Replace sealants which fail because of loss of cohesion or adhesion, or do not cure.

1.08 TESTING

A. Scope: This outline describes field adhesion tests of elastomeric sealants to determine the adhesive and cohesive characteristics of an installed sealant by placing a strain on the sealant. The results of these tests can be used in conjunction with other information to determine the overall performance of the sealant.

B. Procedures

1. Locate test joints where indicated or, if not indicated, as directed by Architect, or Sealant Manufacturer.

2. Conduct field tests for each application indicated for each type of elastomeric sealant and joint substrate provided.

3. Notify Architect or Engineer seven days in advance of dates when tests will be conducted.

4. Arrange for all tests to be conducted by an authorized, qualified sealant manufacturer's representative or independent third-party testing company approved by manufacture.

5. Test joint sealants by hand-pull method described in accordance with ASTM C1521 - 13 Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints and as recommended by manufacture

C. Test Frequency

1. Perform five tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate. Perform one test for each 1000 feet of joint length thereafter. Perform three additional tests for each failed test.

2. Inspect joints for complete fill, for absence of voids, for primer if required, for proper width/depth ratio and back up complying with specified requirements. Record results in an organized chart published by sealant manufacture.

3. Repair sealants pulled in test area by applying new sealants following same procedures used to originally seal joints. Contractor shall test and repair tests areas at no expense to the Owner.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Products specified are listed as standard of quality.

Substitutions: Under Section 01 25 00.

2.02 BUILDING SEALANTS (SEE SEALANT SCHEDULE IN SECTION 3.6 FOR SPECIFIC USE OF SEALANTS)

A. Urethanes:

1. Two-part Urethane: Self-Leveling, ASTM C920, Type M, Grade P, Class 25.

a. Chem-Caulk CC-550, by Bostik.

b. Vulkem 245, by Mameco.

c. Vulkem 255, Wide-Joint, by Mameco.

d. NR-200 Urexpan, by Pecora Corporation.

e. Sikaflex-2c NS/SL, by Sika Corporation.

2. Two-part Urethane: Non-Sag, ASTM C920, Type M, Grade NS, Class 25.

a. Chem-Caulk 500, by Bostik.

b. Vulkem 227, by Mameco.

c. Dynatrol II, by Pecora Corporation.

d. Sikaflex-2c NS/SL, by Sika Corporation.

e. Sonolastic NP 2, by Sonneborn Building Products, ChemRex Inc.

3. One-part Urethane: Self-Leveling, ASTM C920, Type S, Grade P, Class 25.

a. Vulkem 45, by Mameco.

b. Urexpan NR-201, by Pecora Corporation.

c. Sonolastic SL1, by Sonneborn Building Products, ChemRex, Inc.

4. One-part Urethane: Non-Sag, ASTM C920, Type S, Grade NS, Class 25.

a. Chem-Caulk 900, by Bostik.

b. Vulkem 116, by Mameco.

c. Sonolastic NP I, by Sonneborn Building Products, ChemRex, Inc.

B. Silicones:

1. One-part Silicones: ASTMC920, Type S, Grade NS, Class 25. Vertical surfaces only.

a. Sikasil WS 295

b. Sika WS-305 AM50

c. 795 Silicone Structural Glazing, Glazing, and Weatherproofing Sealant, by Dow corning.

d. 864 Architectural Silicone, by Pecora Corporation.

2. One-part Silicones: ASTM C920, Type S, Grade NS, Class 25.

a. Sika GP

b. 786 Mildew-resistant Silicone Sealant, Dow Corning.

c. SCS 1700 Sanitary Sealant, General Electric.

d. 898 Silicone Sanitary Sealant, Pecora Corporation.

C. Acrylics, Latex:

1. One-part Acrylic Latex, Non-Sag, ASTM C834-76.

a. Chem-Calk 600, by Bosstik.

b. LC-130, by MACCO Adhesives, The Glidden Company.

c. Easa-ply ALS, by W.R. Meadows, Inc.

d. AC-20+Silicone Acrylic Latex, by Pecora Corporation.

e. Sonolac, Sonneborn Building Products, ChemRex, Inc.

D. Butyls:

1. One-part Butyl, Non-Sag, FS TT-S-1657.

a. Chem-Calk 300, by Bostik.

b. BC-158 Butyl Rubber, by Pecora Corporation. (ASTM C1085)

E. Preformed Compressible & Non-Compressible Fillers:

1. Backer Rod – Closed cell polyethylene foam:

a. HBR Backer Rod, by Nomaco.

b. #92 Greenrod, by Nomaco.

c. Sonofoam Closed-Cell Backer Rod, Sonneborn Building Products, ChemRex, Inc.

2. Backer Rod – Open cell polyurethane foam:

   a. Denver Foam, by Backer Rod Mfg. Inc.

   b. Foam Pack II, by Nomaco.

3. Neoprene compression seals:

   a. WE, WF, and WG Series, by Watson Bowman & Acme Corp.

   b. Will-Seal 150 Precompressed Expanding Foam Sealants, by Will-Seal, a Division of Illbruck.

4. Butyl Rod: Kirkhill Rubber Co. (714) 529-4901.

F. Bond Breaker Tape: Polyethylene tape of plastic as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate of joint filler must be avoided for proper performance of sealant.

2.03 PAVING SEALANTS

A. Two-part Urethane: Self-Leveling, ASTM C920, Type M, Grade P, Class 25.

1. Vulkem 202, by Mameco. (Jet Fuel Resistant) (FS SS-S-200D, Type H only).

2. NR-300 Urexpan, by Pecora Corporation. (FS SS-S-200E)

B. One-part Urethane: Self-Leveling, ASTM C920, Type S, Grade P, Class 25.

1. Sonomeric 1 Sealant, by Sonneborn Building Products, ChemRex, Inc. (FS SS-S-200E)

2. Vulkem 45, by Mameco.

2.04 COLORS

A. Generally, use sealant colors matching color of material where joint is located.

B. Where a joint occurs between two materials of differing colors contact Architect for color selection.

2.05 ACCESSORIES

A. Joint Cleaner: Provide type of joint cleaning compound recommended by sealant manufacturer for joint surfaces to be cleaned.

B. Primer: As recommended by sealant manufacturer.

C. Masking tape and similar accessories to protect surfaces from damage.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates, and conditions are as required, and ready to receive work.

1. Verify that joint widths are in conformance with sealant manufacturer allowable limits.

2. Verify that contaminants capable of interfering with adhesion have been cleaned form joint and joint properly prepared.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the work of this Section. Do not proceed with work until unsatisfactory conditions have been corrected.

D. By beginning work, contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the client.

3.02 PREPARATION

A. Prepare and size joints in accordance with manufacturer's instructions. Clean substrates of dirt, laitance, dust, or mortar using solvent, abrasion, or sandblasting as recommended by manufacturer. Remove loose materials and foreign matter that might impair adhesion of sealant.

B. Verify that joint shaping materials and release tapes are compatible with sealant and caulking. Verify sealant is suitable for substrate. Verify that sealant is paintable if painted finish is indicated.

C. Protect materials surrounding work of this section from damage or disfiguration.

3.03 INSTALLATION

A. Install sealant in accordance with manufacturer's published instructions. Perform work in accordance with ASTM C804 for solvent release sealants and ASTM C790 for latex base sealants.

B. Prime or seal joint surfaces where recommended by sealant manufacturer. Do not allow primer or sealer to spill or migrate onto adjoining surfaces.

C. Install backer rod and bond breaker tape where required by manufacturer.

D. Install preformed compressible and non-compressible fillers in accordance with manufacturer's published instructions.

E. Install sealants to depths recommended by sealant manufacturer in uniform, continuous ribbons free of air pockets, foreign embedded matter, ridges, and sags, "wetting" joint bond surfaces equally on both sides.

F. Tool joints concave unless shown otherwise. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form slight cove so that joint will not trap moisture and foreign matter. Dry tool joints. Do not use soap, water, or solvent to tool joints.

G. Epoxy Floor Joint Sealant: Install sealant at floor construction and control joints in accordance with manufacturer's published instructions and initially under manufacturer's supervision.

3.04 CURING

A. Cure sealants in compliance with manufacturer's published instructions.

3.05 CLEANING

A. Remove excess and spillage of sealants promptly as the work progresses, using materials and methods as recommended by sealant and substrate manufacturers. Clean adjoining surfaces to eliminate evidence of spillage without damage to adjoining surfaces or finishes.

3.06 SEALANT SCHEDULE

A. Exterior Joints:

1. Perimeters of exterior openings where frames and other penetrations meet exterior façade of building: precast concrete, brick, CMU, polymer reinforced concrete.

a. Sealant No. 2.2 A2

b. Sealant No. 2.2 B1 (for prefinished materials only)

2. Expansion and control joints in exterior surfaces of cast-in-place concrete walls, precast architectural wall panels.

    a. Sealant No. 2.2 A2.

    b. Sealant No. 2.2 A4.

    c. Material No. 2.2 F

3. Expansion and control joints in exterior surfaces of unit masonry walls, and polymer reinforced concrete, including at metal panels, and all exterior joints in cast stone.

    a. Sealant No. 2.2 A2.

4. Coping joints, coping-to-façade joints, cornice and wash, or horizontal surface joints not subject to foot or vehicular traffic.

    a. Sealant No. 2.2 A2

    b. Sealant No. 2.2 A4

    c. Sealant No. 2.2 B1 (for prefinished materials only)

5. Exterior joints in horizontal wearing and non-wearing surfaces.

    a. Sealant No. 2.2 A1

    b. Sealant No. 2.2 A3

    c. Material No. 2.2 F

6. Paving joints and curbs.

    a. Sealant 2.2 A4

    b. Sealant 2.2 B

7. Setting bed for threshold and saddles.

    a. Sealant 2.2 B1

8. Painted metal lap or flashing joints.

    a. Sealant 2.2 B1

B. Interior Joints:

1. Seal interior perimeters of exterior openings.

2. Expansion and control joints on interior of exterior cast-in-place concrete walls.

3. Expansion and control joints on interior of exterior precast, architectural wall panels.

4. Expansion and control joints on interior of exterior surfaces of masonry walls.

5. Perimeters of interior hollow metal and aluminum frames.

6. Interior masonry vertical control joints and intersecting masonry walls; CMU-to-CMU, CMU-to-concrete.

7. For all the above interior joints (1-6):

    a. Sealant No. 2.2 A2

    b. Sealant No. 2.2 A4

    c. Sealant No. 2.2 B1 (for pre-finished materials only)

8. Exposed interior control joints in drywall and concealed joints.

    a. Sealant No. 2.2 C1

    b. Sealant No. 2.2 E1

9. Perimeter of toilet fixtures: sinks, tubs, urinals, water closets, basins, vanities, etc.

    a. Sealant No. 2.2 B2

10. Interior expansion and control joints in floor surfaces exposed to foot traffic.

    a. Sealant No. 2.2 A1

    b. Sealant No. 2.2 A3

    c. Material No. 2.2 F

11. Interior non-moving joints, including control, contraction, or construction joints, in interior floor slabs exposed to heavy duty traffic.

    a. Sealant No. 2.3A

12. Painted metal lap joints:

    a. Sealant 2.2 B1

C. Glazing:

1. General Purpose Glazing

    a. Sealant 2.02 B1

2. End Damming.

    a. Sealant 2.02 B1

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
5. Division 08 Section "Door Hardware".
6. Division 08 Section "Access Control Hardware".
7. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.

6. ANSI/SDI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swing Door Assemblies.
7. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
8. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
9. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
10. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
11. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
12. ASTM E1886 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
13. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes.
14. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
15. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
16. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
17. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
18. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
19. TAS-201-94 - Impact Test Procedures.
20. TAS-202-94 - Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components using Uniform Static Air Pressure.
21. TAS-203-94 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
22. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
23. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

E. Informational Submittals:

1. Hurricane Resistant Openings: Exterior hurricane opening assemblies to be tested according to ASTM E330, ASTM E1886, ASTM E1996 standards, and certified by a qualified independent third party testing agency acceptable to authority having jurisdiction, with labeling indicating compliance with the wind load and design pressure level requirements specified for the Project.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.

2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.
    A. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Hurricane Resistant Exterior Openings (State of Texas): Provide exterior hollow metal and door hardware assemblies approved by the Texas Department of Insurance, including anchorage, capable of withstanding wind load design pressures calculated for this project by a registered architect or engineer and are part of the construction documents per the Texas Department of Insurance, authorities having jurisdiction, and the International Building Code Design Loads Section 1609.

1. Each unit to bear third party permanent label in accordance with the Texas Department of Insurance requirements applicable to project.
2. Hurricane-Resistance Test Performance: Provide hollow metal and door hardware approved assemblies that pass large missile-impact tests, as required by Texas Department of Insurance systems location above grade and cyclic-pressure tests according to testing requirements of authorities having jurisdiction.
    A. Impact Resistance: Hollow metal with approved door hardware assemblies must satisfy the Texas Department of Insurance’s criteria for protection from windborne debris in both the Inland I zone and the Seaward zone. Assemblies must pass the large missile impact test (which equates to Missile Level D specified in ASTM E 1996-02). Assemblies may be installed at any height on the structure as long as the design pressure rating for the assemblies is not exceeded.

F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

    A. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART – 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

    1. CECO Door Products (C).

    2. Curries Company (CU).

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.03 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.

6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. Curries Company (CU) - Polystyrene Core - 707 Series.

2.04 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:
   A. Curries Company (CU) – M Series.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:
   A. Curries Company (CU) - CM Series.
   B. Curries Company (CU) - M Series.

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.05 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

4. Windstorm Opening Anchors: Types as tested and required for indicated wall types to meet specified wind load design criteria.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.06 LOUVERS

A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.

1. Blade Type: Vision proof inverted V or inverted Y.

2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.

2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.07 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C.Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.08 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.09 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.

2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.

3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    A. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.

5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.

7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
    A. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        1. Two anchors per jamb up to 60 inches high.
        2. Three anchors per jamb from 60 to 90 inches high.
        3. Four anchors per jamb from 90 to 120 inches high.
        4. Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
    B. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        5. Three anchors per jamb up to 60 inches high.
        6. Four anchors per jamb from 60 to 90 inches high.
        7. Five anchors per jamb from 90 to 96 inches high.
        8. Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        9. Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
    C. Severe Storm Shelter Openings: Provide jamb, head, and sill anchors in accordance with manufacturer's tested and approved assemblies.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.

4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

D. Jambs and Head: 1/8 inch plus or minus 1/16 inch.

E. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.

F. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

G. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.05 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of

items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION

SECTION 08 21 00
WOOD DOORS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to the work in this section.

1.02 WORK INCLUDED

A. Flush wood doors, plastic laminate finish

1.03 RELATED SECTIONS

A. Section 08 11 00 – Metal Doors and Frames.

B. Section 08 71 00 – Finish Hardware.

C. Section 09 90 00 – Painting.

1.04 REFERENCES

A. AHA A135.4 – Basic Hardboard; American Hardboard Association.

B. AWI P-200 – Architectural Woodwork Quality Standards.

C. NFPA 80 – Standard for Fire Doors and Windows.

D. NFPA 252 – Standard Methods of fire Tests of Door Assemblies

E. UL (BMD) – Building Materials Directory; Underwriters Lab.

F. WH (CERT) – Certification Listings; Warnock Hersey.

1.05 SUBMITTALS

A. Section 01300 – Submittals: Procedure for submittals.

B. Product data; indicate door core material, construction.

C. Illustrate door opening, elevation, sizes, types, swings, undercuts, special blocking for hardware, factory finishing criteria, lite/louver cutout, etc.

D. Samples: Submit one sample of door construction, full size.

E. Samples: Submit two samples of door veneer, 24" X 24" with wood grain, sheen and color.

F. Manufacturer's Installation Instructions, including and special instructions.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with AWI quality standards, Section 01300 and WIC 20 premium grade.

B. Finish doors in accordance with AWI quality standards, Section 1500 and WIC 25.

C. Manufacturer: company specializing in manufacturing the products specified in this section with a minimum of three years experience.

1.07 REGULATORY REQUIREMENTS

A. Fire door construction; conform to NFPA 252. Listed and classified by WHI and acceptable to the authority having jurisdiction.

B. Installed fire door assembly, conform to NFPA 80 for fire class as scheduled.

C. Place labels where visible when doors are installed.

1.08 DELIVERY, STORAGE AND PROTECTION

A. Package, deliver, and store doors in accordance with AWI 1300.

B. Accept doors on site in Mfg. packaging, inspect for damage.

C. Protect doors with resilient packing. Do not store in damp or wet areas where sunlight might bleach product. Break seal on site to permit ventilation.

1.09 PROJECT CONDITIONS

A. Coordinate the work with door opening construction, door frame and hardware installation.

B. Accept tile on site in packaging. Inspect for damage.

1.10 WARRANTY

A. Provide manufacturer's standard door warranty.

B. See Section 01700 closeout submittals for additional warranty requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. VT Industries, Solid core wood doors with high pressure decorative laminate surface. Types and sizes as indicated on the drawings.

2.02 DOOR TYPES

A. Flush Doors

1. 1-3/4" thick, solid core construction, non-rated as indicated.
2. Pre-fit and pre-machined for all hardware (mortised).

2.03 DOOR CORES

A. Non-rated solid core and 20-minute rated doors (45-minute rated doors where noted); AWI Section 1300, type PC-particleboard.

2.04 FABRICATION

A. Fabricate doors in accordance with AWI quality standards including 1 3/8" structural composite top and vertical stiles.

B. Fabricate fire rated doors in accordance with UL/WHI requirements. Attach fire rating label to door.

C. Astragals for fire rated doors; T-shaped, overlapping.

D. Provide solid blocking at lock edge for hardware on doors over 20-minute rating.

E. Provide solid blocking for automatic door bottom.

F. Factory machine doors for finish hardware (mortised).

G. Factory fit doors for frame openings on shop drawings.

H. Provide edge clearances in accordance with AWI 1600.

2.05 FINISH

A. High pressure decorative laminate surface Laminate color as indicated in Drawings or on Finish Schedule.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size of alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and AWI quality standards. Install fire rated doors in accordance with NFPA 80 and Warnock Hersey.

3.03 INSTALLATION – TOLERANCES

A. Conform to AWI requirements for fit and clearance.

B. Conform to AWI Section 1300 requirements for maximum diagonal distortion.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 SCHEDULE

A. Refer to door and frame schedule and design documents.

END OF SECTION

SECTION 08 31 00
ACCESS DOORS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including general and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

Access doors and frame units for walls, ceilings and floors.

1.03 RELATED WORK

A. Section 05 50 00 – Miscellaneous Metals.
B. Section 09 20 00 Gypsum Wallboard, Metal Frame Systems
C. Divisions 22 & 23 – Ductwork and Accessories.
D. Drawings and Finish schedules

1.04 REFERENCES

A. UL – Fire Resistance.

B. Warnock Hersey

C. The National Association of Architectural Metal Manufacturers (NAAMM): Metal Finishes Manual.

1.05 SUBMITTALS

A. Submit in accordance with General Conditions.

B. Shop Drawings: Access doors, each type, showing construction, location and installation details.

C. Manufacturer's Literature and Data: Each type, location.

1.06 COORDINATION & RESPONSIBILITY FOR ACCESS PANELS

A. Determine specific locations and sizes for access panels needed to gain access to concealed equipment & indicate on schedule specified under “submittals” article.

B. Access panels to gain access to equipment specified in Division 15 & 16 and where panels are not shown on drawings are to be provided by the applicable subcontractor and in compliance with requirements listed in these sections.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Specific product or material manufactured by the following listed manufacturers is "acceptable" only if the specific product or material can evidence compliance with requirements of the Contract Documents.

BAUCO Access Panel Solutions, Inc., Contact James Wagner james@accesspanelsolutions.com
info@accesspanelsolutions.com www.accesspanelsolutions.com

B. Substitutions: Under provisions of General Conditions.

2.02 FABRICATION, GENERAL

A. Fabricate components to be straight, square, flat and in same plane where required. Slightly round exposed edges and provide access without burrs, snags and sharp edges. Welds where exposed shall be continuous and ground smooth.

B. Number of locks and non-continuous hinges shall be as required to maintain alignment of panel with frame, except for fire rated doors, the number shall be the same as required by the first test.

C. Provide anchors or make provisions in frame for anchoring to adjacent construction. Provide size, number and location of anchors as required to secure access door in opening and as required by fire test.

2.03 GENERAL PURPOSE ACCESS PANELS VIRTUALLY INVISIBLE FINISH:

A. BAUCO plus-II series: Non-rated recessed access doors with concealed hardware and gypsum board inlay for flush installation.

B. Material Overview: Extruded aluminum alloy 6063-T6 frames and supports complete with 5/8" (15.9 mm) or 1/2" (12.7 mm) moisture and mold resistant gypsum board inlay and galvanized internal steel corner reinforcing. Zinc-plated hardened steel screws, free pivot hinge, safety cable with carabineer hook, vinyl screw caps, and EPDM rubber gaskets.

C. Door: Fabricate using 2.8 mm thick extruded aluminum alloy 6063-T6 frame, screwed in place gypsum board inlay complete with galvanized internal steel corner reinforcing. Exposed top edge of frames shall have a concave meniscus rise to 0.5mm thick to accept finishing compound allowing a near invisible flush frame finish.

D. Frame: Recessed aluminum frame shall provide an edge similar to drywall bead against which the ceiling or wall surface shall be finished allowing a near invisible flush frame finish. Fabricate using 2.8mm thick extruded aluminum alloy 6063-T6 frame, complete with galvanized internal steel corner reinforcing. Frame opening complete with perimeter EPDM gasket maintaining the STC of gypsum board assembly.

Frame model specification:
BPII 58 - for 5/8 board

E. Board: Access Panel inlay shall equal the wall & ceiling specifications to ensure acoustic integrity.

Board Inlay shall match adjacent surface material including:
BAUCO plus-II supplied standard with moisture and mold resistant gypsum board inlay
BAUCO plus-II supplied with tile backer board
BAUCO plus-II supplied with other wallboard specification as required

F. Hinge Detail: Concealed, galvanized steel free pivot hinge shall allow all doors to open 120 degrees. All access panel doors shall be fully removable and complete with a safety cable to secure doors to panel frames with a safety cable, test rated for 135lb (61kg), nylon coated, with crimp connections and spring snap aluminum carabineer.

G. Hinge Location:
BAUCO plus-II panels for ceiling installation will be hinged on the longest side unless specified. When BAUCO plus-II panels are used in a wall installation, the hinges must be located on the floor side.

H. Latching/Locking devices:
Concealed touch latch – standard with a Slotted screwdriver cam latch for limited security (Adds –CAM to product code). In the general employee restrooms / locker rooms provide tamper-resistant torx head cam latches (Adds –TX to product code)

I. Finish: BAUCO plus-II series access panels require finishing using common trade tools. For best results, setting-type gypsum finishing compound is recommended. Apply compound separately to the door leaf and surrounding wall or ceiling area up to recessed access panel frame. No taping required. Door shall receive the same finish and paint (or tile) as the surrounding surfaces. When installed and finished the access panel shall be completely flush with the wall or ceiling surface and only a one sixteenth of an inch shadow gap shall be visible.

J. General Access Panel Dimensions For 5/8” Gypsum board:
Access doors shall be 24” square, unless otherwise shown or required to suit opening in required for accessing controls, valves or other equipment.

K. Single Leaf Custom Doors: Minimum dimension of length or width is 6”. Door sizes can be in increments of 1/8”. Doors larger than 2300 square inches in size or with a length greater than 60” may need to be manufactured as multi leaf doors.

Custom size example: single leaf 16 1/8” x 40” for 5/8” drywall with touch latches.
Product code: 20-58-16.1240

Contact manufacturer for assistance in determining the correct product type for your application.

L. Multi Leaf Custom Doors: Multi leaf access panels shall be used to achieve a large clear opening. There are no cross bars required. Added to the end of the product code is a -2 for two leaves or -3 for three leaves.

Custom size example: double leaf 48" x 48" for 5/8" drywall with touch latches.
Product code: 20-58-4848-2

Contact manufacturer for assistance in determining the correct product type for your application.

M. Access Panel Sizing: BAUCO plus-II dimensions in model number refer to clear opening in door.

N. Framing: For a proper fit between framing members the rough framed opening will be 2 1/2" greater than product code sizing. This 2 1/2" allowance provides the door frame size 1 1/8" plus 1/8" allowance on all sides of the panel.

2.03 ACCESS DOORS, FIRE RATED

A. Door Panel: Provide access door for fire rating indicated in wall or ceiling in appropriate rated construction. Include frame, automatic closing device, hinges, per manufacture's recommendation for a rated access door.

PART 3 – EXECUTION

3.01 LOCATION

A. Provide access panels or doors wherever any valves, traps, dampers, cleanouts and other control items of mechanical, electrical and conveyor work are concealed in wall, partition or gypsum board, plaster, ceiling construction.

B. Use fire rated doors in fire rated partitions and ceilings.

C. Use flush panels in partitions and ceilings, except lay-in acoustical panel ceilings or upward access acoustical title ceilings.

3.02 INSTALLATION, GENERAL

Install access doors in openings to have sides vertical in wall installations, and parallel to ceiling grid or side walls when installed in ceiling. Set frames so that edge of frames without flanges will finish flush with surrounding finish surfaces. Set frames with flanges to overlap opening and so that the face will be uniformly spaced from the finish surface. Set access doors recessed so that the face of the surrounding materials will finish on the same plane, when door is installed.

3.03 ANCHORAGE

Secure frames to adjacent construction using anchors attached to the frames or by use of bolts or screws through the frame members. Type, size and number of anchoring device shall be suitable for the material surrounding the opening, and as required to maintain alignment and resist displacement during normal use of the access door and the building. Anchors for fire rated access

doors shall be as required by the fire test.

3.04 ADJUSTEMENT

Adjust hardware so that the door panel will open freely, and when closed the door panel will be centered within the frame.

END OF SECTION

SECTION 08 39 00
PRESSURE-RESISTANT DOORS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. Section Includes:

1. Single Swing Pedestrian Flood Doors with Frames.

2. Door Hardware.

1.03 RELATED SECTIONS:

A. Division 03 – Cast-In-Place Concrete.

B. Division 04 – Concrete Unit Masonry

C. Division 05 – Structural Steel Framing.

1.04 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation instructions.

B. Shop Drawings: Provide shop drawings showing layout, profiles, and product components, including anchorage, hardware, and finishes. Include dimensional plans, applicable material specifications, elevations and sections detailing mounting and connections, and load diagrams.

1. Contractor to provide manufacturer with field measurements and mounting structure prior to commencement of shop drawings.

C. Factory Testing Documentation: Furnish independent party witnessed factory testing documentation of the same model/type pedestrian flood door demonstrating a maximum leakage rate of 0.040 gallon per hour per linear foot of wetted perimeter, tested in accordance with the procedure set forth by the American National Standard for Flood Mitigation Equipment in ANSI/FM Approvals 2510-2020 section 4.3.3 for a minimum of 22 hours. Maximum leakage rate shall be published as the greater of the leakage rates recorded at both 10% and 100% of the maximum test water height. Leakage shall be collected through all portions of the product assembly which are below the test water depth, including hardware and lockset.

D. Calculations: Upon signed finalization and approval of dimensions, mounting location material and configuration, and load requirements;

1. Submit stamped calculations by a registered professional engineer from within the state or territory where the project will be constructed or substantially improved, to verify the flood door's ability to withstand the design loading.

1.05 CLOSEOUT SUBMITTALS

A. Provide Operation and Maintenance data to include methods for maintaining installed products, precautions against cleaning materials and methods detrimental to finishes and performance.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer must demonstrate a minimum of five (5) years successful experience in design and manufacture of similar flood related closures. Upon request, provide supporting evidence including list of installations, descriptions, name, and method of contact.

B. Minimum Qualifications: Manufacturer must demonstrate compliance and certification of a Quality Management System administered by the International Organization for Standardization (ISO). Documentation of current certification status to be provided upon request.

C. Welder Qualifications: Welders Certified in accordance with American Welding Society Procedures for applicable material used in production of specified product.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging container with identification markings intact until ready for installation.

B. Protect materials from exposure to moisture during storage.

C. Store materials in a dry, warm, ventilated weathertight location. If outdoor storage is required, block materials to store at an incline, to prevent pooling of any moisture and promote runoff. Tarp materials in a tent-like arrangement, elevated above the product with open sides to allow airflow. Store loose or high value components in a dry, controlled environment.

D. Use caution when unloading and handling product to avoid bending, denting, crushing, or other damage to the product.

E. When using forklifts, use forks of proper length to fully support product being moved. Consult "Approved for Construction" drawings or consult with factory for proper lift points.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's indicated limits.

1.09 WARRANTY

A. Manufacturer's Standard Warranty: Product to be free from defects in material and workmanship for a period of one (1) year from date of shipment.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Design flood resistance doors to support, solely or in combinations of, temporary super-imposed live loads as indicated below. All applied types of flood related loadings are transferred from the flood product barriers, solely or in combinations of, by mullion anchorage to structural floor slabs and/or jamb anchorage and direct pressure contact to structural walls or other structural elements.

1. Hydrostatic Loading
2. Hydrodynamic Loading
3. Debris Impact Loading
4. Wave Loading (Dynamic/ Non-Breaking or Broken Wave)
5. Wave Loading (Impact/ Breaking Wave – Below & Above DFE)

6. Wind Loading

B. Engineer Code Practices: Engineer flood products to conform to the design requirements that are based on the latest adopted edition of the International Building Code (IBC). LFRD and/or ASD methodologies are applied as appropriate to align with specific project specifications and/or limited published material data.

C. Factory Testing Documentation: Furnish independent party witnessed factory testing documentation of the same model/type pedestrian flood door demonstrating a maximum leakage rate of 0.040 gallon per hour per linear foot of wetted perimeter, tested in accordance with the procedure set forth by the American National Standard for Flood Mitigation Equipment in ANSI/FM Approvals 2510-2020 section 4.3.3 for a minimum of 22 hours. Maximum leakage rate shall be published as the greater of the leakage rates recorded at both 10% and 100% of the maximum test water height. Leakage shall be collected through all portions of the product assembly which are below the test water depth, including hardware and lockset.

D. Water Density: 64 pcf, unless otherwise noted on drawings.

2.02 MANUFACTURER

A. Description: Hinged, Pedestrian Flood Door including door frame, door panel, threshold, and door hardware.

1. Approved Manufacturer: PS Flood Barriers™, which is located at: 1150 S. 48th Street, Grand Forks, ND 58201; Toll Free Tel: 877.446.1519; Email: 4psinfo@psindustries.com; Web: www.psfloodbarriers.com or www.psindustries.com

1. Basis of Design Product: Model: Hydro1-PD520.

B. Substitutions: Under provisions of Section 01 60 00.

C. Single Source Responsibilities: Obtain all watertight doors and flood protection barriers from single manufacturer.

2.03 EQUIPMENT

A. Products Details:

1. Sealing Requirements: Flood Door and compression gasket design shall provide an effective barrier against short-term high-water situations, to the protection level indicated on drawings.

2. Operation: Provide with latching operable from both sides.

3. Mounting/Load Transfer: Anchor to existing structure. Flood Door designed for specified hydrostatic pressure (and other loads as specified) and will transfer loads to adjacent structure.

4. Frames to be anchored utilizing mechanical, chemical or other framing methods as designed. Manufacturer to include all anchors, water-stop, and sealants, as designed.

    1. Loading Direction:

        1) Positive Pressure Loading, (direction of loading against flood door so as to further compress gaskets against flood door frame - "seating").

5. Provide rectangular door opening with square corners to facilitate easy passage.

6. Provide continuous, compression gasket which does not require air inflation.

2.04 MATERIALS

A. Exposed sheet metal of door panel and door frame to be formed of the following material type;

1. Steel: Commercial quality, low carbon steel of appropriate size and strength, welded and structurally bonded.

B. Flood door internal structure and mullion tube to be structural tubes, plates, and formed shapes of the following material type;

1. Steel: Commercial quality, low carbon steel of appropriate size and strength with welded construction.

C. Gaskets: Factory mounted, continuous, compressible rubber type, field replaceable. Gasket does not require air inflation.

1. Material: UV resistant EPDM, neoprene and rubber unless otherwise noted.

2. Location: Recessed into door perimeter, no gasket along threshold/walking surface.

D. Door Frame to be manufactured of the same material type and finish as door panel. Frame to include jambs, header jamb, and threshold members for field locating and installation on structure. Jamb members to be designed and fabricated with appropriate material as required for the loading.

E. Thresholds to be PS Flood Barriers proprietary threshold:

Aluminum: 6000 Series Alloy.

1. ADA Compliant threshold (no more than ½" high).
2. Gasket-Free walking surface.

F. Frame Mounting Hard ware: Provide anchors, sealant, and water stop, as required.

G. Operating Hardware: Provide hardware appropriate for the size and weight of the flood door and loads. Hardware to be factory located on jambs and door panels, as practical. Latching hardware to be as indicated on drawings. Flood door panel to be factory prepared for applicable latching devices.

1. Aluminum (AL689 finish) Hinge to be continuous type.

2. Standard Latching/Locking Hardware: Interior: Von Duprin 98/99 series Rim exit device. Exterior: Von Duprin 996L Lever, classroom function. (Note: this hardware has been specifically chosen and tested on the Hydro 1 PD-520, substitutions require manufacturer's engineering review.)

3. Closer; Townsteel TDC40 H-CUSH, Heavy Duty Grade 1 (AL689 finish)

H. Finish:

1. Steel Shop Finish: Apply the following paint system in accordance with manufacturer recommendations and instructions;

a. Primer: One shop coat of manufacturer's standard shop primer (S-W Kemflash Primer).
b. Finish: Two shop coats of Standard Industrial Enamel (S-W Industrial and Marine Coatings B54 Series)

I. Labeling: Each watertight door and frame will be individually identified for matched installation.

2.05 FABRICATION

A. Fit and factory assemble items in largest practical sections, for shipment to site.

B. Fabricate items with joints tightly fitted and secured.

C. Supply components required for anchorage of fabrications, unless otherwise noted.

D. Conduct shop operational test with factory installed gaskets to verify flood door assembly components operate as designed and flood protective gasket alignment and contact surfaces interact as intended.

PART 3 – EXECUTION

2.06 EXAMINATION

A. Do not begin installation until mounting substrates have been properly prepared.

B. If substrate preparation is the responsibility of another subcontractor, notify Architect of uncompleted preparation before proceeding.

C. Inspect opening for compliance with door manufacturer requirements. Verify open conditions are within required tolerances.

2.07 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Protect materials surrounding work of this section from damage or disfiguration.

2.08 INSTALLATION

A. Install in accordance with manufacturer's installation instructions, "Approved for Construction" drawings, shipping, handling, and storage instructions, and product carton instructions for installation.

B. Frames must be installed level, square, plumb, and rigid.

C. Perform chalk test for gasket alignment, continuity contact and pre-compression prior to field grouting.

D. Sealants, water-stop, and grouting to be applied per product application directions and in accordance with manufacturer's instructions, and "Approved for Construction" drawings.

E. Field Grouting to be completed by appropriate personnel, and in accordance with product application directions, manufacturer's instructions, and "Approved for Construction" drawings.

F. Tolerances: All dimensional requirements must be in accordance with manufacturer's installation instructions and "Approved for Construction" drawings.

G. Products to be operated and field verified that sealing surfaces maintain contact at the correct sealing points.

H. Inspect gaskets for damage, wear, and adhesion. Replace compromised gaskets immediately.

I. Verify that latching assemblies operate freely and correctly.

J. Verify all anchorage is in accordance with manufacture's installation instructions and applicable data sheets.

K. Inspect installation sealants to ensure a watertight juncture.

2.09 FIELD QUALITY CONTROL

A. Field Testing, installer to preform hose test of door to frame in accordance with manufacturers standard Hose Test Procedure.

2.10 CLEANING

A. Touch-up, repair or replace damaged products or components before Substantial Completion.

B. Clean all sealing surfaces.

2.11 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION

SECTION 08 41 00
ALUMINUM ENTRANCES, STOREFRONTS, AND WINDOWS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. Extent of aluminum entrances, storefronts and windows are indicated on drawings and schedules and shall be designed for Wind Zone 3, Risk Category III, Missile Level E for enhanced protection.

B. Aluminum doors, frames, storefront and window types required for the project include:

Exterior and interior aluminum entrance doors and frames.
Exterior aluminum framed windows
Glazing for all aluminum doors.

C. Ensure door surfaces comply with ANSI A117.1 section 404.2.10, and that bottom rails of doors have the top leading edge tapered at no less than 60 degrees from the horizontal to meet compliance.

1.03 RELATED WORK

A. Section 07 62 00 – Metal Flashing and Trim.

B. Section 07 92 00 – Caulking and Sealant.

C. Section 08 71 00 – Finish Hardware.

D. Section 08 80 00 – Glass and Glazing.

1.04 REFERENCES

A. Aluminum Association (AA):

1. AA-M12 C22 A41.

B. American Architectural Manufacturers Association (AAMA):

1. AAMA 605.2.
2. AAMA 701.2.
3. AAMA – Curtain Wall Manual #10.
4. AAMA-SFM-1 – Aluminum Storefront and Entrance Manual.
5. AAMA 501-2-94 Field Water Test

C. American Society for Testing and Materials (ASTM):

1. ASTM B209.
2. ASTM B221.
3. ASTM A36/A36M.
4. ASTM A386.
5. ASTM E330.
6. ASTM E283.
7. ASTM E331.
8. ASTM D2287.
9. ASTM D2287.
10. ASTM D2000.
11. ASTM E1996

1.05 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Submit manufacturer's product specifications, technical product data, standard details, and installation recommendations for each type of entrance and storefront product required. Include the following information:

Component dimensions and description.
Anchorage and fasteners.
Glass and infill.
Internal drainage details.
Fabrication methods.
Finishing.
Hardware.
Accessories.

C. Shop Drawings: Submit manufacturer shop drawings for fabrication and installation of entrances and storefronts, including the following:

Elevations.
Detail sections of typical composite members.
Hardware, mounting heights.
Anchorages and reinforcements.
Expansion provisions.
Glazing details.

D. Certification: Provide certified test results showing that entrance and storefront systems have been tested by a recognized testing laboratory or agency and comply with specified performance characteristics. Also provide "Energy Performance Certificates: indicating minimum NFRC-certified energy performance values for each system meets minimum IECC requirements. Submit for each aluminum framed entrances, storefronts and windows."

E. Samples:

1. Aluminum Extrusions: Submit one sample 12" (300 mm) long in size illustrating finished aluminum surface. Include sample sill, subsill and jamb with all flashing in masonry mockup sample.

F. Provide engineering calculations signed and sealed by a registered engineer confirming the size and reinforcing of the storefront including impact and wind resistance for local conditions and requirements, including design for Wind Zone 3, Risk Category III, Missile Level E for enhanced protection.

G. Provide professional sealed engineering calculations indicating design and anchoring of the entire system is capable of withstanding the wind loads and impact criteria for this exposure as required by ASCE-7 and the design criteria listed on the Structural drawings and in the general notes.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility: Provide entrance and storefront produced by a single manufacturer capable of showing prior production of units like those required.

B. Installer's Qualifications: Entrances and storefront shall be installed by a firm that has not less than five-years successful experience in the installation of systems like those required.

C. Design Criteria: Drawings indicate sizes, spacings of members, profiles and dimensional requirements of entrance and storefront work. Minor deviations will be accepted to utilize manufacturer's standard products when, in the Architect's sole judgement, such deviations do not materially detract from the design concept or intended performances. Manufacture shall provide engineer drawings indicating system has been designed by an engineer registered to practice in Texas and that the system is designed for this wind zone.

D. Water Testing: Per AAMA 501.2-03 to be performed randomly at half of the windows and all the storefronts by an AAMA certified testing agency. For each failed test, two more windows shall be tested. Submit written findings and results to architect

1.07 PROJECT CONDITIONS

A. Field Measurement: Check openings by field measurement before fabrication to ensure proper fitting of work; show measurements on final shop drawings, coordinate fabrication schedule with construction progress to avoid delay in the work.

1.08 WARRANTY

Warranty period for aluminum entrances, curtain wall, and storefront is 2 years after the date of substantial completion.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products specified are manufactured by the Kawneer Company, Inc. and are listed as a standard of quality.

B. Products of the following conforming with the requirements of the specification are acceptable:

Amarlite/Arco Metals Co.
Oldcastle
PPG Industries, Inc.
Tubelite Div., Indal, Inc.
United States Aluminum Corp., C.R. Lawrence Co.
Vistawall

C. Substitutions: Under provisions of Section 01 60 00.
+

2.02 COMPONENTS

A. Framing System: Interior: TRIFAB VG 451 Framing system, Exterior: TRIFAB VG 451T, by Kawneer Company, Inc. 2 x 4-1/2" nominal dimension, minimum wall thickness of 0.080", extruded aluminum flush glazed framing system.

B. Doors:

1. Series 500 swing door, wide stile, by Kawneer Company, Inc. Door sizes indicated on drawings.
   a. Vertical Stile: 5" single piece.
   b. Top Rail: 5" single piece.
   c. Bottom Rail: 10" single piece.
   d. Glazing: Exterior:1" insulated tinted, tempered glass per Section 08 80 00, with standard bevel glass stops must be TDI certified for Missile Impacts rating.

C. Glass and Glazing Materials:

1. Glazing Materials: As specified in Section 08 80 00.

D. Sealant Materials:

1. Perimeter Sealant: Type as specified in Section 07 92 00.
2. Sealant Used Within System (Not used for glazing): Type as specified in Section 07 92 00.

E. Hardware:

1. Refer to General Conditions: Verification of hardware components specified in Section 08 71 00.
2. Closers: See Section 08 71 00.

3. Pivots: Door manufacturer's standard top and bottom offset pivots. Finish Dark Bronze.
4. Locking Devices (where noted in Section 08710): Adams Rite MS+1891 latch/lock with double cylinder operation. Finish: Dark Bronze.
   a. Cylinders: See Section 08 71 00.
5. Push/Pulls: Type CP-2 push, and type CO-9 pull, by Kawneer Company, Inc. Finish Dark Bronze.
6. Exit Devices: See Section 08 71 00. (Provide Exit Device).
7. Weatherstripping, for exterior doors only:
   a. Head and Jamb: Replaceable wool, polypropylene, or nylon wool pile with aluminum strip backing, recessed in frame; AAMA 701.2.
   b. Sill: Semi-rigid polymeric material on aluminum anodized to match door; EPDM sweep strip; 38-560 by Kawneer or similar by other named manufacturers.

Flashing and Weatherstripping for Windows:

a. Provide flashing sills set in sealant
b. Provide zone dams at ends of flashing.

F. Threshold: See Section 08 71 00. (Provide Threshold).

G. Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements, sag resistance and rigidity.

H. Dissimilar Metals: Separate dissimilar metals with zinc chromate primer, bituminous paint, or other separator that will prevent corrosion.

I. Fasteners: Conceal fasteners wherever possible.

J. Water Deflectors: To be installed at the ends of each intermediate horizontal.

K. W-Blocks: To be installed in the deep pockets of each lite of glass to keep the glass from shifting.

L. Flashing: Manufacturer's standard extruded flashing or similar required at the storefront and curtain wall sill. Include end dams.

M. Thermal Barrier (Trifab VG 451T):

1. Kawneer IsoLock® Thermal Break with a 1/4" (6.4) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.

   a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

2.03 FINISHES

A. Exposed Aluminum Surfaces: Color to be selected by architect. Finish shall meet AAMA2605 and equal to Kawneer, Fluropon 70% PVDF Performance colors.

B. Maintain same color range on doors, frames, and other components. Do not mix light and dark shades.

C. Concealed Steel Items: Galvanized in accordance with ASTM A386 to 2.0 oz/sq. ft.

D. Apply two coats of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Verify field measurements, surfaces, substrates, and conditions for installation of work.

B. Comply with manufacturer's instructions and recommendations for installation. Include miscellaneous blocking, nailing strips and framing where required as backing for attachment of Door and Window frames as required for complete installation.

C. Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Provide proper support and anchor securely in place.

D. Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Comply with requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA 101-85.

E. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

F. Provide thermal isolation where components penetrate or disrupt building insulation.

G. Install sill flashings. Turn up ends and edges; seal to adjacent work to form watertight dam.

H. Coordinate attachments and seal of perimeter air and vapor barrier materials.

I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

J. Set thresholds in bed of mastic and secure.

K. Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.

L. Install glass in accordance with Section 08 80 00.

M. Install perimeter sealant, backing materials, and installation criteria in accordance Section 07 92 00.

3.02 ADJUSTING

A. Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight closure.

3.03 CLEANING

A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.

B. Clean glass surfaces after installation, complying with requirements contained in the "Glass and Glazing" section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt, and other substances from aluminum surfaces.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

Part 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
4. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ANSI/SDI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swing Door Assemblies.
3. ASTM E1886 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
4. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure difference.
5. ASTM E1996 - Standard specification for performance of exterior windows, curtain walls, doors and storm shutters impacted by Windborne Debris in Hurricanes.

6. ICC/IBC - International Building Code.
7. NFPA 70 - National Electrical Code.
8. NFPA 80 - Fire Doors and Windows.
9. NFPA 101 - Life Safety Code.
10. NFPA 105 - Installation of Smoke Door Assemblies.
11. TAS-201-94 - Impact Test Procedures.
12. TAS-202-94 - Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components using Uniform Static Air Pressure.
13. TAS-203-94 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
14. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.03 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

A. Type, style, function, size, label, hand, and finish of each door hardware item.

B. Manufacturer of each item.

C. Fastenings and other pertinent information.

D. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

E. Explanation of abbreviations, symbols, and codes contained in schedule.

F. Mounting locations for door hardware.

G. Door and frame sizes and materials.

H. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

I. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.

J. Complete (risers, point-to-point) access control system block wiring diagrams.

K. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Hurricane Resistant Openings: Exterior hurricane opening assemblies to be tested according to ASTM E330, ASTM E1886, ASTM E1996 standards, and certified by a qualified independent third party testing agency acceptable to authority having jurisdiction, with labeling indicating

compliance with the wind load and design pressure level requirements specified for the Project.

2. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.04 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Hurricane Resistant Exterior Openings (State of Texas): Provide exterior hollow metal and door hardware assemblies approved by the Texas Department of Insurance, including anchorage, capable of withstanding wind load design pressures calculated for this project by a registered architect or engineer and are part of the construction documents per the Texas Department of Insurance, authorities having jurisdiction, and the International Building Code Design Loads Section 1609.

1. Each unit to bear third party permanent label in accordance with the Texas Department of Insurance requirements applicable to project.
2. Hurricane Resistance Test Performance: Provide hollow metal and door hardware approved assemblies that pass large missile-impact tests, as required by Texas Department of Insurance systems location above grade and cyclic-pressure tests according to testing requirements of authorities having jurisdiction.
    A. Impact Resistance: Hollow metal with approved door hardware assemblies must satisfy the Texas Department of Insurance's criteria for protection from windborne debris in both the Inland I zone and the Seaward zone. Assemblies must pass the large missile impact test (which equates to Missile Level D specified in ASTM E 1996-02). Assemblies may be installed at any height on the structure as long as the design pressure rating for the assemblies is not exceeded.

G. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

J. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.06 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.07 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

1.08 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART – 2 PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.02 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

A. Two Hinges: For doors with heights up to 60 inches.

B. Three Hinges: For doors with heights 61 to 90 inches.

C. Four Hinges: For doors with heights 91 to 120 inches.

D. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

A. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.

B. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

C. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.

D. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

E. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

F. McKinney (MK) - TA/T4A Series, 5 knuckle.

2.03 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

G. McKinney (MK) - QC (# wires) Option.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

H. McKinney (MK) - Electrical Connecting Kit: QC-R001.

I. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

J. McKinney (MK) - QC-C Series.

2.04 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
6. Manufacturers:

K. Rockwood (RO).

2.05 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

L. Match Existing, Field Verify.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.

3. Existing System: Field verify and key cylinders to match Owner's existing system.

D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).

E. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.06 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

A. Lund Equipment (LU).

B. MMF Industries (MM).

C. Telkee (TK).

2.07 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Manufacturers:

A. Corbin Russwin Hardware (RU) - ML2000 Series.

B. Sargent Manufacturing (SA) - 8200 Series.

2.08 INTEGRATED WIRED OUTPUT LOCKING DEVICES – MULTI-CLASS READER

A. Integrated Wired Output Multi-Class Mortise Locks: Wiegand or Open Supervised Device Protocol (OSDP) output ANSI A156.13, Grade 1, mortise lockset with integrated card reader with or without keypad option, request-to-exit signaling, door position status switch, and latchbolt monitoring in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle trim, 3/4" deadlocking anti-friction latch, and 1" case-hardened steel deadbolt. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Latchbolt monitoring and door position switch act in conjunction to report door-in-frame (DPS) and door latched (door closed and latched) conditions.
2. Integrated reader supports the following credentials:
   A. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
   B. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
   C. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
   D. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
   E. NFC-enabled mobile phones
   F. PIN code only or PIN + credential with keypad option.
3. 12VDC external power supply required for reader and lock, with optional 24VDC lock solenoid. Fail safe or fail secure options.
4. Energy Efficient Design: Provide lock bodies which have a holding current draw of 500mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
5. Support end-of-line resistors contained within the lock case.
6. Installation requires only one cable run from the lock to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
7. Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.
8. Manufacturers:
   G. Corbin Russwin (RU) – ML2000 SN Series.
   H. Sargent Manufacturing (SA) – SN200/SN210 8200 Series.

B. Hurricane and Tornado Resistance Compliance: Integrated Wired output access control locking devices to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate hurricane or tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.

2.09 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    A. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    B. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
12. Hurricane and Tornado Resistance Compliance: Conventional exit devices are to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate hurricane or tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:
   A. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
   B. Sargent Manufacturing (SA) - 80 Series.

2.11 ELECTROMECHANICAL EXIT DEVICES

A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.

1. Energy Efficient Design: Provide devices which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
2. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.
3. Manufacturers:
   A. Corbin Russwin Hardware (RU) - ED5000 Series.
   B. Sargent Manufacturing (SA) - 80 Series.

2.12 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard..

1. Manufacturers:
   A. Corbin Russwin Hardware (RU) - DC6000 Series.
   B. Norton Rixson (NO) - 7500 Series.
   C. Sargent Manufacturing (SA) - 351 Series.

2.13 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

   A. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

   B. Manufacturers:

      1. Rockwood (RO).

2.14 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

   1. Manufacturers:

      C. Rockwood (RO).

2.15 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

   1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers:
    A. Pemko (PE).

2.16 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
    1. Manufacturers:
        A. Securitron (SU) - DPS Series.

B. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.
    1. Manufacturers:
        A. Securitron (SU) - AQD Series.

2.17 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART – 3 EXECUTION

3.01 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.03 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.04 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.06 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.07 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.08 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. OT - Other
3. RU - Corbin Russwin
4. RO - Rockwood
5. PE - Pemko
6. SU - Securitron

Set: 1.0

Doors: 100

Description: Ext Aluminum - Access Control

1	Pivot Set / IM Pivots	By aluminum door manufacturer		OT
1	EM Pivot	By aluminum door manufacturer		OT
1	Rim Exit Device, MELR	ED4200S K157ET MELR	613E	RU
1	Cylinder	Match facility standards		
1	Door Pull	RM3300-24 Mtg-Type 12HD	US10BE	RO

1	Surface Closer	DC6210 A11 brkt/spacer as req		613E	RU
1	Threshold	2005DT	PE		
1	Perimeter Seal	By door mfgr		OT	
1	Rain Guard	346D	PE		
1	Sweep	3452DV	PE		
1	Elec Cables - Exit to Hinge	QC-C***P			MK
1	Elec Cables - Hinge to Above	QC-C1500P			MK
1	Position Switch	DPS-M-BK		SU	
1	Power Supply	AQD Series		SU	
1	Electric Power Transfer	EL-CEPT		SU	
1	Card Reader	By Security Contractor.		OT	

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per aluminum door manufacturer which may differ from what was used for specification. Confirm all hardware compatibility with aluminum storefront manufacturer. TDI requirements
Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 2.0

Doors: 116A, 116B

Description: Ext Aluminum Passage Exit

1	Pivot Set / IM Pivots	By aluminum door manufacturer			OT
1	Rim Exit Device, Passage	ED4200S 106810ET		613E	RU

1	Surface Closer	DC6210 A11 brkt/spacer as req		613E	RU
1	Threshold	2005DT	PE		
1	Perimeter Seal	By door mfgr		OT	
1	Rain Guard	346D	PE		
1	Sweep	3452DV	PE		

Notes: Confirm hardware compatibility with aluminum door manufacturer.
Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per aluminum door manufacturer which may differ from what was used for specification. TDI Requirements.

Set: 3.0

Doors: 114, 115A, 115B

Description: Exterior Sgl Exit - MELR Access Control

2	Hinge (heavy weight)	T4A3386 (NRP)	US32D	MK	
1	Hinge, Full Mortise, Hvy Wt	T4A3386 QC*	US32D	MK	
1	Rim Exit Device, MELR	ED5200S 106957ET M107 MELR	630	RU	
1	Cylinder	Match facility standards			
1	Surface Closer	DC6210 A11 brkt / spacer as req	689	RU	
1	Kick Plate	K1050 10" x 2" LDW CSK	US32D	RO	
1	Threshold	2005AT	PE		
1	Gasketing	303AS	PE		
1	Rain Guard	346C	PE		
1	Sweep	3452AV	PE		

1	Elec Cables - Exit to Hinge	QC-C***P		MK
1	Elec Cables - Hinge to Above	QC-C1500P		MK
1	Position Switch	DPS-M-BK	SU	
1	Power Supply	AQD Series	SU	
1	Card Reader	By Security Contractor.	OT	

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer. TDI Requirements.

Set: 4.0

Doors: 106, 107, 112

Description: Int Sgl - Access Control Lock

2	Hinge, Full Mortise	TA2714	US26D	MK		
1	Elec Hinge	TA2714 QC	US26D	MK		
1	Access Control Mort Lock	ML20606 x SN200-SEC 106W		626	RU	
1	Cylinder	Match facility standards				
1	Door Closer	DC6200 / DC6200 A4 as required		689	RU	
1	Kick Plate	K1050 10" x 2" LDW BEV CSK	US32D	RO		
1	Gasketing	S88BL	PE			
1	Elec Cables - Lock to Hinge	QC-C***P		MK		
1	Elec Cables - Hinge to Above	QC-C1500P		MK		
1	Position Switch	DPS-M-BK	SU			
1	Power Supply	AQD Series	SU			

1	Card Reader	By Security Contractor.	OT

Notes: Door is normally closed and secure. Presentation of valid credential will allow entry by trim. Free egress at all times. Upon loss of power, door will remain secure. RX where required is by security contractor.

Set: 5.0

Doors: 102

Description: Storage

3	Hinge, Full Mortise	TA2714		US26D	MK
1	Storeroom Lock	ML2057 106W	626	RU	
1	Cylinder	Match facility standards			
1	Door Stop	406/409/441CU as req		US26D	RO
3	Silencer	608		RO	

Set: 6.0

Doors: 111

Description: Sgl - Storeroom - Closer - gasket

3	Hinge, Full Mortise	TA2714		US26D	MK
1	Storeroom Lock	ML2057 106W	626	RU	
1	Cylinder	Match facility standards			
1	Door Closer	DC6200 / DC6200 A4 as required		689	RU
1	Kick Plate	K1050 10" x 2" LDW CSK		US32D	RO

1	Door Stop	406 / 441CU as required	US26D	RO
1	Gasketing	S773D LAR	PE	

Set: 7.0

Doors: 103

Description: Office

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Entrance Lock	ML2053 106W 626	RU	
1	Cylinder	Match facility standards		
1	Door Stop	406/409/441CU as req	US26D	RO
3	Silencer	608	RO	

Set: 8.0

Doors: 105

Description: Pull/Pull closer

3	Hinge (heavy weight)	T4A3786	US26D	MK
2	Door Pull	RM3300-24 Mtg-Type 12HD	US10BE	RO
1	Door Closer	DC6200 / DC6200 A4 as required	689	RU
1	Door Stop	406 / 441CU as required	US26D	RO
3	Silencer	608	RO	

Set: 9.0

Doors: 113

Description: Push/Pull closer

3	Hinge (heavy weight)	T4A3786		US26D	MK	
1	Push Plate	70E	US32D	RO		
1	Door Pull	RM3300-24 Mtg-Type 12HD		US10BE	RO	
1	Door Closer	DC6200 / DC6200 A4 as required		689	RU	
1	Door Stop	406 / 441CU as required		US26D	RO	
3	Silencer	608	RO			

Set: 10.0

Doors: 108, 109, 110

Description: Restroom closer

3	Hinge, Full Mortise	TA2714		US26D	MK	
1	Privacy Lock	ML2030 106VN V20		626	RU	
1	Door Closer	DC6200 / DC6200 A4 as required		689	RU	
1	Kick Plate	K1050 10" x 2" LDW BEV CSK		US32D	RO	
1	Door Stop	406 / 441CU as required		US26D	RO	
1	Gasketing	S88BL	PE			

END OF SECTION 087100

SECTION 08 80 00
GLASS AND GLAZING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Glass and glazing for hollow metal work and aluminum storefront.

1. Exterior glass and glazing.
2. Interior glass tempered, clear glass.
3. All exterior glazing shall be designed for Wind Zone 3, Risk Category III, Missile Level E for enhanced protection.

1.03 RELATED WORK

A. Section 07 92 00 – Caulking and Sealant.

B. Section 08 14 00 – Wood Doors.

C. Section 08 41 00 – Aluminum Entrances, Storefronts, and Windows.

D. Section 10 28 00 – Toilet and Shower Accessories.

1.04 REFERENCES

A. ASTM C804 – Use of solvent – release type sealants.

B. ASTM C864 – Dense elastomeric compression seal gaskets, setting blocks and spaces.

C. ASTM C920 – Elastomeric joint sealants.

D. ASTM C1036 – Standard Specification for Flat Glass

E. ASTM C1048 – Standard Specification for Heat-Treated Flat Glass

F. ASTM E84 – Surface burning characteristics of building materials.

G. ASTM E283 – Test method for rate of air leakage through exterior windows, curtain walls, and doors.

H. ASTM E 773 – Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units.

I. ASTM E 774 – Standard Specification for Classification of the Durability of Sealed Insulating Glass Units.

J. GANA – Glass Association of North America Glazing Manual

K. GANA – Glass Association of North America Laminated Glazing Reference Manual

L. IGCC – Insulating Glass Certification Council

M. ASTM E1996 Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

1.05 QUALITY ASSURANCE

A. Perform glazed work per written recommendations of the glass manufacturer or glass fabricator and the Glass Association of North America (GANA) Glazing Manual.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

C. Identification: Each unit of tempered glass shall be permanently identified by the manufacturer. The identification shall be etched, or ceramic fired on the glass and be visible when the unit is glazed.

1.06 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated on the drawings and in the schedule at the end of this Section are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
   a. Specified Design Wind Loads:
      reference Design Wind Loads as stated on Structural Drawing and Texas Department of Windstorm Requirements stated on Structural Drawings.
   b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15° off vertical and under wind action for load duration of 60 seconds or less.
   c. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1” (25 mm), whichever is less.

1) For monolithic-glass lites heat treated to resist wind loads.
2) For insulating glass.
3) For laminated-glass lites.

d. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120° F (67 C), ambient; 180 F (10 C), material surfaces.

1.07 SUBMITTALS

A. Submit product data under General Conditions.

B. Product Data:

1. Glass: Structural, physical, and environmental characteristics, size limitations, special handling, or installation requirements.
2. Glazing Compound: Provide chemical, functional, and environmental characteristics, limitations, special application requirements.

C. Samples:

1. Glazing: Submit one sample 12 x 12" (300 x 300 mm) in size of each type of glazing, illustrating tinting, and finish of glazing materials. Label each sample indicating kind, quality and manufacturer.

D. Assurance/Control Submittals:

1. Certificates: Manufacturer's certificate that products meet or exceed specified requirement including design for Wind Zone 3, Risk Category III, Missile Level E for enhanced protection.
2. Insulating glass units shall be rated as meeting class CBA as certified by IGCC (Insulating Glass Certification Council).
3. Qualification Documentation: Submit documentation of experience indicating compliance with specified qualification requirements.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Deliver, store, and protect products to site under provisions of General Conditions.

1.09 WARRANTY

A. Standard warranty per the General Conditions.

B. Special Warranty:

1. Include coverage for cracking, breakage, and replacement of same.
   a. Warranty Period: one year.

PART 2 – PRODUCTS

2.01 ACCEPTABLE GLASS MANUFACTURERS

A. Products specified are manufactured and fabricated by Vitro. They are listed as a standard of quality.

B. Products of PPG Industries, AGC Industries, Pilkington, Visteon, AFG Industries, Inc and Guardian Industries conforming to specification requirements are acceptable.

C. Substitutions: Under provisions of General Conditions.

2.02 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
   a. Wind Design Data: As indicated on Drawings.

D. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with enhanced-protection testing requirements in ASTM E 1996 for criteria listed on Structural design notes when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.

1. Large-Missile Test: For glazing located within 30’ (9.1 m) of grade.
2. Small-Missile Test: For glazing located more than 30’ (9.1 m) above grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.03 GLASS MATERIALS

A. Type I – Insulated double pane, interior pane of clear tempered glass; exterior pane of low-E tempered glass, laminated to meet the requirements of high impact, hurricane design.

1. Provide clear Solarban 90 (2), clear + clear, designed by manufacturers qualified professional engineer to meet the performance criteria listed herein, including windborne-debris-impact resistance, with a min total thickness of 1 5/16.
2. Performance Characteristics - Performance data calculated using Lawrence Berkeley Laboratory Window5.2 software:
   Visible Light Transmittance: 51%
   ASHRAE U-Value Winter: .29
   Solar Heat Gain Coefficient: .23
   Light to solar gain (LSG): 2.22

   Type II – Clear glass, 1/4" thick, clear float glass Unless greater than 12 sf which should then be 5/16" or as recommended by manufacture for size indicated per ASTM C1048. (at all interior glazing locations unless otherwise noted)

B. Exterior doors glass to match adjacent storefront laminated insulated glazing. Coordinate with Aluminum frame manufacture to assure proper setting in door.

C. Provide Heat Treated or tempered safety glass as indicated on drawings and where required by code.

D. Obscure glass (Obscure glass not applicable for this project unless otherwise noted).

E. Spandrel glazing: (Spandrel glass not applicable for this project)

2.04 GLAZING COMPOUNDS

A. Glazing Compounds: Glass: An elastic compound for glazing metal. Color to match frame finish.

B. Setting Blocks and Spacer Shims: Fabricate blocks and shims from neoprene shaped to the required size and thickness. The hardness for setting block and shim material shall be as recommended by the glass manufacturer.

PART 3 – EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that field measurements, surfaces, substrates, and conditions are as required, and ready to

receive work.

1. Verify that openings for glazing are correctly sized and within tolerance.
2. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

B. By beginning work, contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost.

3.02 GLAZING

A. Glazing shall be per the procedures recommended in the Glazing Manual of the Glass Association of North America (GANA), the glass manufacturer or glass fabricator.

B. Markings, banners, and posters shall not be applied directly to glass surfaces.

3.03 CLEANING

A. At completion of work, all glass shall be free from cracks, chips, scratches and other defects. Defective glass shall be removed and replaced with new undamaged glass.

B. Glass and surrounds shall be thoroughly cleaned and maintained clean.

END OF SECTION

SECTION 09 20 00
GYPSUM WALLBOARD, METAL FRAME SYSTEMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work in this section.

1.02 WORK INCLUDED

A. Design and installation of metal framing required for interior gypsum board, and non-load-bearing walls

B. Gypsum board and exterior sheathing.

C. Shaft Liner

D. Accessories.

1.03 RELATED WORK

A. Section 04 22 00 – Concrete Masonry Units (not applicable on this project)

B. Section 05 40 00 – Cold Form Metal Framing

C. Section 06 10 00 – Rough Carpentry

D. Section 07 21 00 – Insulation

E. Section 07 62 00 – Metal Flashing and Trim

F. Section 07 84 00 – Firestopping

G. Section 07 92 00 – Caulking and Sealant

H. Section 08 31 00 – Access Doors

I. Section 09 90 00 – Painting

J. Section 14 24 00 – MRL Hydraulic Elevators

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):
B. ASTM C 475 – Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

C. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
D. ASTM C840 – Standard Specification for Application and Finishing Gypsum Wallboard.
E. ASTM C 645 – Standard Specification for Nonstructural Steel Framing Members.
F. ASTM C 1002 – Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
G. ASTM C1396 – Standard Specification for Gypsum Board.

1.05 SUBMITTALS

A. Conform to the requirements of the General Conditions.
B. Shop Drawings:

1. Indicated methods of securing studs and framing to tracks and deflection tracks, suspension, and general manufacture product data.

C. Assurance/Control Submittals:

1. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
2. Qualification Documentation: Submit documentation of experience indicating compliance with specified qualification requirements.

D. Samples:

1. Submit two samples of gypsum board finish 2'-0" square illustrating finish color and texture. Resubmit sample as required by the Architect to establish standard of quality. Light stipple texture (also see painting spec section)

E. System Description:

1. Design system in accordance with referenced standards to accommodate construction tolerances, deflection of building structural members, and clearance at openings.
2. Maximum allowable deflection L/360.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

B. Performance:

1. Perform gypsum board installation in accordance with ASTM C840.
2. Perform metal stud framing in accordance with ASTM C754

1.07 DELIVERY, STORAGE AND HANDLING

A. General Conditions – Product Requirements: Transport, handle, store, and protect Products.

B. Protect metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

C. Store and protect materials with weatherproof covering and ventilate to avoid condensation.

D. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. ClarkDietrich

B. Georgia Pacific

C. National Gypsum Company

D. Substitutions: Under provisions of General Conditions.

2.02 MATERIALS

A. Gypsum Wallboard Materials:

1. All gypsum wallboard (walls and ceilings) to be Type X, Fire resistant, 5/8” thick, 48” wide, ends square cut; tapered edges,. unless noted otherwise.
   a. Georgia Pacific DensArmor Plus Interior Panels
   b. National Gypsum, eXP Interior Extreme

2. All areas to receive ceramic tile: ASTM C1178, fiberglass faced Type X; moisture resistant with mold and mildew inhibitors; (MR) 5/8-inch-thick; 48” wide; maximum permissible length; ends square cut; tapered edges equal to Georgia Pacific, DensShield Tile Backer or Gold Bond Building Products, LLC provided by National Gypsum Company eXP Fire-Shield Tile Backer.

3. Mold and moisture resistant - (In all Janitor closets, Fire Riser room, mechanical rooms, and where indicated on drawings, unless otherwise required for ceramic tile) to be fiberglass faced, ASTM C1658, Type X 5/8” thick, 48” wide Georgia Pacific DensArmor Plus or Gold Bond Building Products, LLC provided by National Gypsum Company Gold Bond eXP Interior Extreme Fire-Shield Gypsum Panel.

4. Exterior Sheathing at exterior walls to be fiberglass faced, ASTM C1177 5/8” Type X Georgia Pacific DensGlass or Gold Bond Building Products, LLC provided by National Gypsum Company Gold Bond eXP Fire-Shield Sheathing.

5. Backside of parapets and where roofing products are adhered to be fiberglass faced, ASTM C1177 gypsum roof boards by Georgia Pacific DensDeck Prime, Gold Bond Building Products, LLC provided by National Gypsum Company DEXcell FA Glass Mat Roof Board or USG Securock Gypsum-Fiber Board.

6. Shaft Liner – Provide 1" DensGlass Shaftliner by Georgia Pacific or Gold Bond eXP Shaftliner by Gold Bond Building Products, LLC provided by National Gypsum Company with fiberglass mats and moisture resistant gypsum core at elevator shaft, ASTM C1658. Include all necessary trim and accessories to install per manufactures recommendations to achieve a 1 hour rated elevator shaft.

B. Fasteners:

1. Fasteners, Wallboard: 1" and 1-5/8" USG Brand HI-LO Type S Bugle Head Screws.
2. Fasteners, Stud to Runners: ASTM C1002, Self-Drilling, Self-Taping, 3/8" USG Brand Type S Pan Head Screws.
3. Fasteners, Stud to Door Frame: 3/8" USG Brand Type S-12 Pan Head Screws.
4. Fasteners, Accessories: 9/16" rosin-coated staples.
5. Track or Runners to Structural Steel: Power driven anchors.

D. Accessories:

1. Corner Beads: USG Dur-A-Bead Corner Reinforcement No. 103 or ClarkDietrich 103 Deluxe Corner Bead (CBU).
2. Casing Beads: USG Metal Trim 200B or ClarkDietrich Metal L-Trim #200-B (M20B).
3. Control Joint: USG 093 or ClarkDietrich 093 Zinc Control Joint.
4. Expansion Joint: ClarkDietrich #40 Two-Piece Expansion Joint.

E. Carrying Channels: Channels shall be 1-1/2" cold rolled channels weighing not less than 475 pounds per 1000 lineal feet. Channels shall be given a coat of rust inhibitive paint.

F. Hangers: Hangers for suspended work shall be 8-gauge galvanized wire.

G. Ties: Tie wire for furring channels to carrying channels shall be 18-gauge, annealed wire or drywall furring channel clips.

H. Finishes:

1. Galvanizing: ASTM A653, G60; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
2. Primer: FS TT-P-645, touch-up for galvanized surfaces.

PART 3 – EXECUTION

3.01 ERECTION – GENERAL

A. Verification of Conditions:

1. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   a. Verify that building framing components are ready to receive Work and that the building is dried in and will not get wet.
   b. Verify that rough-in utilities are in-place and located where required.
2. Report in writing to Architect conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have corrected.
3. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost.

B. Standards: Unless modified or exceeded by the requirements of this Specification, conform to framing system manufacturer's recommendations and then to the following specification:

1. GA-216: Recommended specifications for the application and finishing of gypsum board.
2. Fire Rated Assemblies: Assemblies of materials for fire-rated installation shall meet or exceed the required rating as per drawings.

C. Recesses: Where recesses are required for the installation of work under other sections, the fire rating and sound rating integrity of the partitions shall be maintained within the recess by continuing all required surface layers of gypsum wall board into all faces of the recess.

D. Coordination: Coordinate installation of frames, anchors, blocking, electrical and mechanical work which is to be placed in or behind framing. Allow such items to be installed after framing is complete. Refer to partition types on drawing for sound control batts.

E. Wallboard screws shall be applied within an electric screw gun. Screws shall be driven not less than 3/8” from ends or edge of wallboard to provide uniform dimple not over 1/32” deep.

3.02 ERECTION OF PARTITION SYSTEMS

A. Runners shall be aligned accurately and securely anchored at 24”-o.c. to concrete with power driven anchors to suspended ceilings with toggle or molly bolts to structural steel with power drive anchors.

B. Studs shall be placed not to exceed 24”-o.c. into runners except where indicated on the drawings otherwise and shall be secured to runners with screws, two at top and two at bottom.

C. Fabricate corners using a minimum of three studs.

D. Double stud at wall openings, door and window jambs, not more than 2” from each side of openings.

E. Brace stud framing system rigid.

F. Coordinate erection of studs with requirements of door frames, window frames. Install supports and attachments.

G. Coordinate installation of wood bucks, anchors, and wood blocking with electrical and mechanical work to be placed within or behind stud framing.

H. Blocking: Secure wood blocking to studs. Install blocking for support of MEP items, toilets partitions, wall cabinets, toilet accessories, and hardware.

I. Refer to drawings for indication of partitions extending to finished ceiling only and for partitions extending through the ceiling to the structure above.

J. All partitions not scheduled to extend to structure above shall be braced at a maximum of 4 feet-o.c. with diagonal bracing extending to structure above at alternate sides of the partition. Where firestopping is required, provide double top runners as indicated.

K. Chase wall studs shall be a double row of studs positioned vertically in the runners so studs are opposite each other in pairs Studs shall be spaced at maximum 16”-o.c... Cross bracing between rows of studs shall be made of wallboard, 12” by chase width, screw-attached to the end stud webs at quarter points in the partition height, with one-inch screws spaced 8”-o.c. in each stud web

L. Metal door, window and borrowed light frame: Minimum double 20-gauge studs shall be located within 2” of all jambs and shall run full height from floor to roof deck above and shall be anchored to the jamb and head anchor clips of each frame by bolt or screw attachment. Over frames, a cut-to-length section of runner shall be installed with the flanges slit and web bent to allow flanges to overlap adjacent vertical studs and shall be securely screw-attached to adjacent studs. A cut-to-length stud extending from doorframe header to ceiling runner shall be positioned at vertical joints over doorframe.

3.03 GYPSUM BOARD INSTALLATION

A. Single-layer wallboard shall be applied face out with long dimension vertical full height. All abutting ends and edges shall occur over stud flanges. Joints on opposite sides of a partition shall occur on different studs. Screws shall be spaced 12”-o.c. in the field of the board and 8”-o.c. staggered along the vertical abutting edges.

B. Double-layer wallboard shall be applied with the long dimension vertical full height and with vertical joints on opposite sides of the partition staggered. The base layer shall be attached with one-inch screws spaced 12”-o.c. in the field and 8”-o.c. along vertical joints of the board. The face layer shall be applied with vertical joints offset 16” from the base-layer joints and staggered on opposite sides of the partition. Face layer shall be attached with 1-5/8” screws spaced 12”-o.c. in the field of the board and 8”-o.c. staggered along vertical joints on the board.

C. Wallboard shall be cut to fit neatly around all outlets and switch boxes.

D. Tape, fill and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

E. Provisions for heavy fixture anchorage and anchorage of surface-mounted items shall be as indicated on the drawings and as specified.

F. If there are any paper products on this project, then it shall not be installed until the building is watertight or the contractor assumes all responsibility. All paper backed gypsum board that gets wet shall be immediately replaced as directed by the Owner/Architect. Fiberglass backed products should be warranted for a 12 month exposure however if they are submerged or sitting in water or exposed to cascading water they shall be replaced

G. Treat cut edges, holes and end butts in exterior gypsum sheathing with sealant and tape all joints with system recommended by sheathing manufacture.

3.04 ERECTION OF SUSPENDED CEILING SYSTEM AND ATTACHED CEILING SYSTEM

A. Install in accordance with ASTM C754 and GA-216.

B. For suspended ceilings, erect 1-1/2" carrying channels 4'-0"-o.c. Carrying channels shall not be let into nor come in contact with abutting partitions. The carrying channels shall be located within 6" of the paralleling walls to support the ends of the cross furring. The ends of the carrying channels at walls shall be supported by hangers located not more than 6" from each end. Hanger shall be spaced at 4'-0"-o.c. each way and anchored to the structure above.

C. When carrying channels are spliced, the ends shall be overlapped not less than 12" with flanges of channels interlocked and securely tied near each end of the splice with double loops of No. 18-gauge wire.

D. Erect furring channels at 16"-o.c. and securely saddle tie to carrying channel with two strands of 18-gauge ties or drywall furring channel clips in accordance with manufacturer's direction.

E. Attach furring channels at 16"-o.c. to structural steel members in accordance with the manufacturer's recommendations.

F. When furring members are spliced, the ends shall be overlapped not less than 8" with flanges of channels interlocked and securely tied with double loops of No. 18-gauge wire.

G. Single Layer Application: Wallboard shall be applied with the long dimension at right angles to the furring channels for sub-ceilings. All other ceilings shall have wallboard applied in the longest practical length with long dimension at right angles to the furring channels. End joints shall be centered over furring channels, neatly fitted and staggered. Wallboard shall be properly supported around all cutouts and openings in ceilings. One" screw fasteners shall be spaced a maximum of 12"-o.c. in the field of the board and along abutting ends or edges.

H. Wallboard shall be cut to fit neatly around all outlet boxes.

3.05 ERECTION OF WALL FURRING

A. Hat-Shaped Wall Furring:

1. Furring channels shall be attached to solid surfaces, either vertically or horizontally at 24”-o.c. with hammerset or power activated stud fasteners, or concrete stub nails spaced 24”-o.c. through alternate wing flanges of the furring channel.
2. Wallboard shall be applied with the long dimension at right angles to furring channels. All abutting end or edge joints shall occur over the web surface of furring channel and shall be fitted neatly and accurately. End joints shall be staggered. Wallboard shall be fastened with one” screws, spaced 12”-o.c. along each furring channel.
3. Wallboard shall be cut to fit neatly around wall outlets and switch boxes.

3.06 ACCESSORIES

A. Where gypsum board finishes against a dissimilar material, gypsum board shall be finished into a casing bead. Casing bead shall be installed over face-layer of gypsum board attached with fasteners spaced 12”-o.c. and shall be in single lengths unless application length exceeds standard stock lengths.

B. All vertical or horizontal external corners of gypsum board shall have corner beads. Corner beads shall be attached with fasteners spaced 12”-o.c. on both sides and shall be in single lengths unless corner length exceeds standard stock lengths.

C. Provide a vertical control joint at each side of column furr cut and one control joint each side of column in gypsum board where no furr-out is required. Provide a control joint in corners where interior wall meets the exterior wall and at corners of exterior walls. Place vertical control joints at each window and door jamb (juncture of jamb at sill and head) and extend full height of gypsum board wall. Provide additional control joints as indicated on drawings, or if not indicated, a maximum of 20’ on center on straight run walls and ceilings. Stop control joint at base to allow for a smooth continuous flush base without projections at each joint

3.07 CLEANING

At the completion of installation, all rubbish shall be removed, leaving floors broom clean. Excess material, scaffolding, tools and other equipment shall be removed from the building and job site.

END OF SECTION

(updated March 2022 – from Gladys Breese at Clark Dietrich and Frank Fuller at National Gyp)

SECTION 09 30 00

CERAMIC TILE

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work in this section.

1.02 WORK INCLUDED

A. Ceramic floor tile floors installed using thinset method, with cementitious grouted joints.

B. Ceramic tile walls and base installed using thinset methods, with cementitious grouted joints.

C. Thresholds and transition strips – See drawings and Finish Schedule for type and color.

1.03 RELATED WORK

Section 07 92 00 – Caulking and Sealant: Expansion joint materials and sealant. Section 09 34 00 – Waterproofing Membrane Ceramic Tiling

1.04 REFERENCES

A. ANSI A108.4 – Ceramic Tile Installed with Water-Resistant Organic Adhesives.

B. ANSI A108.5 – Ceramic tile Installed with Dry-set Portland Cement Mortar.

C. ANSI A118.4 – Latex-Portland Cement Mortar.

D. ANSI A136.1 – Organic Adhesives for Installation of Ceramic Tile.

E. TCA 137.1 – Recommended Standard Specifications for Ceramic Tile.

F. TCA – Tile Council of America, Inc., 1999 Handbook for Ceramic Tile Installation.

1.05 QUALITY ASSURANCE

A. Conform to ANSI – American National Standard Specifications for the Installation of Ceramic Tile.

B. Conform to ANSI – Recommended Standard Specifications for Ceramic Tile - TCA 137.1.

1.06 SUBMITTALS

A. Submit product data, specifications, and instruction for using adhesives and grouts.

B. Submit samples of colors proposed for use.

C. Submit manufacturer's certification that tile materials supplied conform to TCA 137.1

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's unopened containers with grade seals unbroken and labels intact.

B. Protect adhesives and liquid additives from freezing or overheating in accordance with manufacturer's instructions.

C. Store tile and setting material under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Product manufactures are as indicated on Drawing schedules and are listed as a standard of quality.

B. Substitutions: Under provisions of Section 01 60 00 – Product Requirements.

2.02 CERAMIC and PORCELAIN TILE

A. Wall Tile: sizes and types as indicated on finish schedule.

B. Floor Tile: sizes and types as indicated on finish schedule

C. Trim:

a. Furnish type, size, and color to match tile as selected in the Finish Legend.
b. Observe following requirements unless otherwise indicated on finish schedule:
    1. Base: As indicated on Drawings.
    2. In-Corners: Square.
    3. Out-Corners and exposed edges: Schluter trim whether or not specifically scheduled and indicated on drawings.
    4. Curbs: Bullnose, cover, or Schluter trim as scheduled and indicated on drawings however in no case shall it exceed 1/2 inch total rise with a max of 1/4 inch step and 1/4 inch slope.

2.03 SETTING MATERIALS

A. Latex-Portland Cement Mortar: ANSI A118.4

B. Organic Adhesive ANSI A136.1, Type 1.

C. Bond coat: Dry set mortar or latex-portland cement mortar on a cured bed.

1. Cured Bed:
    a. Dry-Set Mortar: ANSI A118.1

b. Latex-Portland Cement Mortar: ANSI A118.4

2.04 GROUT MATERIALS

A. Type of Grout:

1. Laticrete Spectralock Pro epoxy grout – color as scheduled or selected by architect from manufacture's standards

2.05 MORTAR MIX

Proportion all mixes in accordance with ANSI Standard specifications.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Floor Tile: The installation of floor tile scheduled thinset method, shall be installed using Latex-Portland Cement Mortar, Method F113-92, Handbook for ceramic Tile Installation, in accordance with applicable requirements of ANSI standard A108.5.

B. Wall Tile and Base: The installation of wall tile scheduled thinset, and installed over gypsum board or water-resistant gypsum board, shall be installed using Organic Adhesive, Method W243-92, Handbook for Ceramic tile Installation in accordance with applicable requirements of ANSI Standards ANSI A108.4.

C. Cut and fit tile tight to protrusions and perpendicular interruptions. Form corners and bases neatly

D. Contractor shall layout the tile (wall and floor) prior to beginning to minimize cuts. When cuts are necessary, at no time shall less than one third of the tile face be left remaining.

E. Form internal angles square and external angles bullnosed.

F. Work tile joints uniform in width, subject to variance in tolerance allowed in tile size. Joints shall be watertight, without voids, cracks, excess mortar or grout.

G. Sound tile after setting. Replace hollow sounding units.

H. The internal vertical corner joints of all wall tile shall be filled with a sealant as specified under Section 07 92 00 – Caulking and Sealant.

I. All joints between doorframes and tile shall be filled with a sealant as specified under Section 07 92 00 – Caulking and Sealant.

J. Keep expansion joints and sealant joints free of mortar or grout.

J. Allow tile to set for minimum 48 hours prior to grouting.

K. Where tile flooring joins other flooring, if the finished surfaces are not flush, install transition as

indicated on the drawings and the finish schedule.

L. Where wall tile is used on walls with windows in them, return the tile inside the jamb and head to the frame.

M. Seal grout and tile as recommended by manufacturer. Minimum 3 coats until water is not absorbed.

3.02 CLEANING

Upon completion of setting and grouting, sponge and wash tile thoroughly. Finally polish with clean dry cloths. Acid shall not be used to clean tile.

3.03 PROTECTION

Prohibit traffic from floor finish and activities near wall finish for a minimum of 48 hours after installation.

END OF SECTION

SECTION 09 30 50
EXTERIOR TILE SETTING & ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface Preparation Products: Backerboards, Waterproofing, and Crack Isolation Membranes.

B. Setting Materials: Large and Heavy Tile Mortars (formerly Medium Bed).

C. Colored Tile Grouts: High-Performance Cement Grouts.

1.02 RELATED SECTIONS

A. Section 07140 - Fluid applied waterproofing.

B. Section 07900 - Expansion and control joints.

C. Section 09252 - Cementitious Backer Board

D. Section 09300 - Tile; Ceramic tile, quarry tile, paver tile.

1.03 REFERENCES

A. ANSI A108 Series - American National Standards for Installation of Ceramic Tile.

B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile,

C. ANSI A118 Series - American National Standards for Installation of Ceramic Tile.

D. ANSI A136.1 - Organic Adhesives for Installation of Ceramic Tile.

E. TCNA - Handbook for Ceramic Tile Installation.

F. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.

G. ASTM C 794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products of this section with minimum ten years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.
   1. Installer shall be a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
   2. Installer's on site supervisor shall hold the International Masonry Institute's Foreman Certification.
   3. Installer shall employ Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Locate mock-ups on site in locations and size directed by Architect.
   2. Finish areas designated by Architect.
   3. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   4. Refinish mock-up area as required to produce acceptable work.
   5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of Work.
   6. Obtain Architect's acceptance of mock-ups before start of final unit of Work.

D. Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

E. During and after completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the mortar manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the architect seventy-two (72) hours prior to the manufacturer's final inspection.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage and contamination to materials by water, freezing, foreign matter and other causes.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Environmental: Install mortar, set and grout tile when surfaces and ambient temperature is minimum 50 degrees F (10 degrees C) and maximum 90 degrees F (32 degrees C). Consult with manufacturer for specific requirements.

C. Do not install mortar, set or grout tile exterior when inclement weather conditions are expected within 48 hours after work is completed unless properly protected.

D. Protection: Protect adjacent work surfaces during tile work. Close rooms or spaces to traffic of all types until mortar and grout has set.

E. Safety: Observe the manufacturer's safety instructions including those pertaining to ventilation.

1.08 WARRANTY

A. Products shall be provided with the manufacturers standard warranty as follows:
   1. Installation Systems Limited Warranty:
      a. Lifetime.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Installation accessories as manufactured by LATICRETE International, Inc., 1 LATICRETE Park North, Bethany, CT 06524-3423 USA. Phone 800-243-4788, https://laticrete.com
   1. Contact: Wesley Brown – (469) – 745-9074

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.02 MATERIALS

A. Cementitious Tile Adhesives:
   1. ANSI A118.15, Improved Modified Dry-Set Mortars: Where indicated on the Drawings, and elsewhere as required for setting tile as specified by ANSI A108.5, Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar, over substrates prepared accordingly.
      a. For Installing Large Format Ceramic or Natural Stone Tile (Tile with one edge greater than 15 inches), utilizing a Medium bed Mortar System.
         1) Laticrete Multimax Lite as manufactured by Laticrete International, Inc. With Shear Bond Strengths greater than 650 psi, per ANSI A118.15 sec. 7.2.5. For wall and floor assemblies where maximum strength is desired.

B. Tile Grout: Where indicated on the Drawings, and elsewhere as required for filling the joints between tiles. Complies with ANSI A108.10 Installation of Grout in tile work.

1. Polymer-Modified Portland Cement Grout:
    a. Laticrete Permacolor Select as manufactured by Laticrete International, Inc., ANSI A118.7, for joints 1/8 inch (3 mm) - 1/2 inch (13 mm). Standard cement grout for wide joints.

C. Elastomeric Joint Sealant: Provide where indicated on the Drawings, and elsewhere as required at all joints between floors and walls and at joints between tile and dissimilar materials.
    1. Laticrete Latasil as manufactured for Laticrete International, Inc. Conforms to ASTM C 920 for movement joints in heavy traffic areas and ASTM C 794.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces, which are to receive tile.

B. Do not proceed with work until defects or conditions which would adversely affect quality, execution and permanence of finished tile work are corrected (ANSI A108.3).

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Condition of surface to receive tile.
    1. Assure that surfaces to receive tile are stable, flat, firm, dry, clean and free of oil, waxes and curing compounds, must meet ANSI A108.1 requirements and be suitable for the specific project usage.
    2. Deflection of substrate not to exceed 1/360th of the span 1/2 inch (12 mm) in 15 feet (4.6 m) in accordance with ANSI A108.01-2.3. Allow for live and impact load as well as dead load weight of tile and setting bed.
    3. Protect adjacent surfaces prior to beginning tile work.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Surface Preparation for Tile and Stone Work.
    1. General:
        a. All supporting surfaces shall be structurally sound, solid, stable, level, plumb, and true to a tolerance in plane of 1/4 inch (6 mm) in 10 feet 0 inch (3 m) for walls, 1/4 inch (6 mm) in 10 feet (3 m) for floors when specified for thin-set method. When installing large format tile with one side greater than 15 inches

or 38 cm, the tolerance is reduced to 1/8 inch in 10 feet (3 mm in 3 m). ANSI A108.01 section 2.6.2

b. Surfaces shall be clean and free of dust, oil, grease paint, tar, wax, curing compound, primer, sealer, form release agent, laitance, loosely bonded topping, loose particles and deleterious substance and debris which may prevent and reduce adhesion.

c. Mechanically sand and scarify the substrate to completely remove all paint, loosely bonded topping, loose particles and construction debris.

d. Neutralize any trace of strong acid and alkali.

e. All substrates shall be dry. The moisture content shall not exceed 50 percent.

f. Turn off all forced ventilation and radiant heating systems and protect work against drafts during installation and for a period of at least 72 hours, at 70 degrees F / 21 degrees C, after completion. Use indirect auxiliary heaters to maintain the temperatures in the area at the recommended workable level. Vent temporary heater to exterior to prevent damage to tile work from carbon dioxide build-up.

g. Before work commences examine the areas to be covered and report any flaw or adverse condition in writing to the architect and to the general contractor. Do not proceed with work until surfaces and conditions comply with the requirements indicated in ANSI A108 specifications.

2. Backerboard Units Installation of Floors, Decks or Countertops:

a. Cementitious Backerboard shall be installed per the guidelines in ANSI A108.11.

C. Install tile in accordance with appropriate ANSI A108 specifications and manufacturer's directions.

D. Expansion joints, control joints, insulation joints, etc., must be located in compliance with TCA EJ171 and filled with appropriate materials.

1. Joints must be carried through all layers of installation materials including tile, setting bed, mortar bed and reinforcing wire. Refer to TCNA Handbook, EJ171 and ANSI AN-3.8 for details on placement, size and specifications of materials.) .

E. Install grout in accordance with Grout ANSI A108.10 specifications and manufacturer's directions.

F. Install elastomeric tile sealant around sinks, tubs and showers and where tile meets tile or another surface. Surfaces should be clean, dry and free of all contamination. Maximum joint width and depth should not exceed 1/4 inch (6 mm).

3.04 PROTECTION

A. Protect finished installation under provisions of section 01500 [01 50 00]. To avoid damage to finished tile work, schedule floor installations to begin only after all structural work, building enclosure, and overhead finishing work are completed.

B. Due to the slow rate of Portland cement hydration and strength development at low temperatures, protect installations exposed to these conditions from traffic for longer than normal periods. Protect newly installed exterior adhered veneer installations from direct

exposure to rain for 7 days at 70 degrees F (21 degrees C). Protection applies to the substrate, the installation of adhesives and joint grouts, post-installation rain and temperature protection until suitable cure, and the storage and handling of the cladding material. Extend period of protection of tile work at lower temperatures, below 60 degrees F (15 degrees C), and at high relative humidity greater than 70 percent relative humidity (R.H.) due to retarded set times of mortar/adhesives. For every 18 degrees F (10 degrees C) below 70 degrees F (21 degrees C) installation materials will take twice as long to cure. Large format tiles require longer curing periods in cooler temperatures. Keep all traffic off the finished work until full cure. Suitable protection is to be included in the scope of work. Each component must reach a proper cure prior to installing the subsequent installation product.

C. Tent / shade and heat areas that will be subjected to the elements or freezing temperatures during installation and cure periods.

D. To Replace or restore work of other trades damaged or soiled by work under this section.

3.05 SCHEDULES

A. Install tile using TCNA methods indicated on the Drawings.

B. Install tile using TCNA methods indicated on the Drawings.
   1. Wall Tile at exterior: Install in accordance with TCNA method W244E.

END OF SECTION

SECTION 09 34 00
WATERPROOF - MEMBRANE CERAMIC TILING

PART 1 – GENERAL

1.01 REFERENCES

A. ANSI A108.13 Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.

B. ANSI A118.10 Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.

C. ASTM C-627 – Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester.

1.02 QUALITY ASSURANCE

A. Use qualified workers thoroughly skilled and experienced in current ANSI A 108 standards and Tile Council of America (TCA) recommendations.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical information and installation instructions for materials required.

1.04 PROJECT CONDITIONS

A. Comply with bonding agent manufacturer's recommended procedures for hot or cold weather.

PART 2 – PRODUCTS

2.1 MEMBRANE

A. WATERPROOF MEMBRANE: Waterproof and crack prevention equal to Product Name RedGard® Waterproofing and Crack Prevention Membrane by Custom Building Products, 10400 Pioneer Boulevard, Unit 3 Santa Fe Springs, CA 90670. Customer Support: 800-272-8786 Technical Services: 800-282-8786 Fax: 800- 200-7765 Email: contactus@cbpmail.net custombuildingproducts.com

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine substrates to verify they are ready to receive tile and membrane with no deficiency that could result in a potentially defective installation. Prepared substrates to be in accordance with ANSI A108, A3.1 and Tile Council of America (TCA) recommendations.

3.2 INSTALLATION

A. Install membrane and tile per ANSI A108.13, ANSI requirements for thin-set methods and manufacturer's printed instructions.

B. Install membrane with products or methods approved in writing by manufacturer when joining, sealing, or fastening or adhering sheet membrane.

3.3 FIELD QUALITY CONTROL WATER TEST

A. Upon completion of work, plug drain or dam areas and fill with water. After 24 hours inspect for leakage. Make necessary adjustments to stop leakage and re-test until watertight.

3.4 PROTECTION

A. Protect membrane from pedestrian or vehicular traffic and prolonged exposure to sunlight.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 WORK INCLUDED

A. Suspended metal grid system, complete with wall trim and accessories.

B. Lay-in acoustical ceiling panels.

1.03 RELATED WORK

Division 15: Air diffusers within ceiling system.
Division 16: Lighting fixtures within ceiling system.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C 635 – Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
2. ASTM C 636 – Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
3. ASTM 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
4. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.
5. ASTM E 1264 Classification for Acoustical Ceiling Products.
6. ASTM E 1477 Standard Test Method for Luminous Reflectance Factor of Acoustical Materials.

1.05 SUBMITTALS

A. Submittals as per Section 01 33 00 – Submittals.

B. Submit product data.

C. Submit one sample of each lay-in panel proposed to be used, approximately 12” square.

D. Provide 1 extra unopened box of acoustical panels for each type, pattern and color.

1.06 STORAGE AND HANDLING

A. Handle and store all ceiling materials on site and deliver to owner as same.

PART 2 – PRODUCTS

2.01 SUSPENSION SYSTEMS

A. Acceptable Manufacturers:

1. Products specified are manufactured by Armstrong World Industries, Inc. and are listed as a standard of quality.
2. Products of Chicago Metallic Corporation, Donn Corporation, and USG Interiors, conforming to specification requirements are acceptable.
3. Substitutions: Under provisions in DIV01

B. Material Description:

1. Members shall be designed to support all imposed loads on the ceiling assembly, including lights, diffusers, insulation, etc. without deflecting more than 1/360 of a 4’ span, mid-point reading.
2. Grid system shall be 15/16” exposed tee system, grid color white.

2.02 HANGER WIRE

Hanger wire shall be soft annealed galvanized No. 12 gage wire per ASTM A641.

2.03 ACOUSTICAL PANELS

A. Acceptable Manufacturers:

1. Products specified are manufactured by Armstrong World Industries, Inc and are listed as a standard of quality.
2. Products of Celotex and USG conforming to specification requirements are acceptable.
3. Substitutions: Under provisions of DIV01

B. Acoustical Ceiling Panel

1. Product of Design: Armstrong ULTIMA high NRC, 1941, 2 x 2 Acoustical Units: Units as scheduled and defined below. Fine texture; wet formed mineral fiber; factory-applied latex paint; (Clean ceiling tile where scheduled) edge as scheduled; 87 percent light reflectance; 0.80 NRC range; 30 - 34 STC range; 0-25 flame spread; Armstrong 15/16" grid system. See drawings for location.

2. Product of Design: Armstrong Kitchen Zone 673, 2 x 2 Acoustical Units: Units as scheduled and defined below. Wet-formed mineral fiber; factory-applied latex paint; (Clean ceiling tile where scheduled) edge as scheduled; 89 percent light reflectance; 0-25 flame spread; Armstrong 15/16" aluminum grid system. See drawings for location. Disinfectable, mold/mildew resistant, washable, scratch and soil resistant.

PART 3 – EXECUTION

3.01 ACOUSTICAL LAY-IN AND SUSPENSION CEILING INSTALLATION:

A. Install acoustical ceiling systems in accordance with ASTM C636 and manufacturer's printed instructions to produce finished ceiling true to lines and levels and free from warped, soiled, or damaged grid or lay-in panels.

B. Install ceiling systems in a manner capable of supporting all superimposed loads, with maximum permissible deflection of 1/360 of span and maximum surface deviation of 1/8" in 10'.

C. Install after all major above-ceiling work is complete. Coordinate the location of hangers with other work.

D. Suspension system shall be installed by direct suspension from the structure by hanger wires at not more than 4' intervals. Provide additional hanger wires to support fixture loads by supplementary hangers located within 6" of each corner. Hanger wires shall be plumb and straight.

E. Hang independently of walls, columns, ducts, pipes, and conduit. Where carrying members are spliced, avoid visible displacement of the longitudinal axis or face plane of adjacent members.

F. Where pattern is not indicated on drawings, center ceiling systems on room axis leaving equal border pieces.

G. Install edge moldings at intersection of ceiling and vertical surfaces, using maximum lengths, straight, true to line and level. Miter corners.

H. Fit acoustic lay-in panels in place, free from damaged edges or other defects detrimental to appearance and function. Fit border units neatly against abutting surfaces.

I. Install lay-in panels level, in uniform plane and free from twist, warp, and dents.

J. Contractor to take appropriate action to prevent any damage to tiles with the use of cotton fiber gloves during installation.

3.02 ADJUSTMENTS

Adjust any sags or twists which develop in the ceiling system and replace any part which is damaged or faulty.

3.03 CLEANING

Upon completion of work, replace any soiled or damaged material.

3.04 PROTECTION

Protect all finish surfaces from damage during construction.

END OF SECTION

SECTION 09 65 13
RUBBER BASE

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.

1.02 WORK INCLUDED

A. Rubber base.

B. Cleaning of all surfaces and areas of work.

1.03 REFERENCES

FS SS-W-40 - Wall Base: Rubber and vinyl plastic.

1.04 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00 – Submittals.

B. Submit product data and samples.

1.05 ENVIRONMENTAL REQUIREMENTS

Maintain minimum 70°F air temperature at installation area for three days prior to, during and for 24 hours after installation.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products specified are manufactured by Tarkett/Johnsonite and are listed as a standard of quality.

B. Products of Tarkett/Johnsonite, Roppe, Allstate, and Pirelli conforming to specification requirements are acceptable.

C. Substitutions: Under provisions of Section 01 60 00 – Product Requirements.

2.02 MATERIALS

A. Resilient Base: 6"-high, 1/8”-thick as indicated on drawings. Use preformed Inside and outside corner pieces.

B. Adhesive: Waterproof, of brand and grade recommended by the manufacturer of tile, base.

C. Color: As scheduled or selected from manufacturer's standard colors.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Products under this section shall be installed in strict accordance with manufacturer's printed instructions.
B. Base shall be installed in full lengths to the extent possible. All cuts shall be made neat and square. Pre-molded units shall be installed at all external corners. Internal corners of base shall be coped.

C. Upon completion of the work, the entire surface of work under this section shall be cleaned; all adhesive removed from other surfaces.

D. Replace damaged materials.

END OF SECTION

SECTION 09 65 19
REILIENT TILE FLOORING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Luxury vinyl tile.

2. Rubber floor tile.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Initial Selection: For each type of floor tile indicated.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

E. Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

F. Product Schedule: For floor tile.

G. Qualification Data: For qualified Installer.

H. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer. Store floor tiles on flat surfaces.

1.06 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Follow manufacturer directions on floor protection in space during, and after installation.

1.07 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 5%, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.01 Luxury Vinyl Tile (LVT)

A. Basis-of-Design Product: Tarkett LVT, substitutions under provisions of General Conditions and shall be approved by architect prior to bid meeting.

1. Tarkett North America, 30000 Aurora Rd. Solon, Ohio 44139. (800) 899-8916

B. Tile Standard: ASTM F 1700, Class II, Type B

C. Wearing Surface: Embossed.

D. Edge Treatment: Square

E. Thickness/Wearlayer: .120” (3.05 mm)

F. Size: 6” x 36” Plank

G. Installation Method: Adhesive, product of design recommended by manufacturer

1. Tarkett Rollsmart Adhesive
2. Tarkett 959 Vinyl Tile and Plank Adhesive
3. Tarkett 975 Two-Part Urethane Adhesives

H. Colors and Patterns: Reference Finish Legend

I. Test Data

1. Techtonic™ scratch, scuff, and abrasion resistance surface

2. Wear layer: 0.020 inches (0.5 mm)
3. Size, Squareness, ASTM F2055: Passes
4. Flexibilty, ASTM F137: Passes
5. Chemical Resistance, ASTM E925: Passes
6. Static Load Limit, ASTM F970: 250 psi, ≤ 0.005 inches
7. Resistance to Heat, ASTM F1514: ΔE ≤ 8
8. Resistance to Light, ASTM F1515: ΔE ≤ 8
9. Residual Indentation, ASTM F1914: Passes
10. Static Coefficient of Friction (SCOF), ASTM D2047: ≥ 0.5 SCOF
11. Dimensional Stability, ASTM F2199: Passes
12. Flamability, ASTM E648 Critical Radiant Flux: Class 1 (≥ 0.45 W/cm^2)
13. Smoke Density, ASTM E662: ≤ 450
14. Limited Commercial Warranty: 20 years

2.02 RUBBER FLOOR TILE (RF)

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; Norament Grano

B. Tile Standard: ASTM F 1344, Class I-B, homogeneous rubber tile, through mottled, Grade 2

C. Hardness: 82 achieved, measured using Shore, Type A durometer per ASTM D 2240

D. Wearing Surface: Hammered Texture

E. Thickness: .14" (3.5 mm)

F. Size: Reference Finish Legend

G. Installation Method: Adhesive, product of design recommended by manufacturer

H. Colors and Patterns: Reference Finish Legend

2.03 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

C. Seamless-Installation Accessories:
   1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
      a. Color: Reference Finish Legend

2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

    a. Use chemical-bonding compound that has a VOC content of 350 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate as recommended by manufacture.

    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level measurement that is approved by manufacture.

    c. A pH test for alkalinity must be conducted on the concrete floor prior to installation with results between 7 and 9. If the test results are not within the acceptable range, then installation much not proceed until the problem has been corrected.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction If built-in items are required to be set on top of tile, indicate on Drawings and revise first paragraph below.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.

3.04 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.

2. Sweep and vacuum surfaces thoroughly.

3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply the quantity of coat(s) as recommended by manufacturer.

E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.

F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.

1. Sealer: Apply two base coats of liquid sealer.

2. Finish: Apply the quantity of coats of liquid floor finish as recommended by manufacturer.

G. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 67 23
RESINOUS FLOORING

PART 1 – GENERAL

1.01 SUMMARY

A filled two-component, 100% solids epoxy that consists of epoxy resin and colored quartz aggregate or flake chips seal coated with a thick coat, 100% aliphatic urethane for an attractive, slip-resistant surface on interior concrete floors. Complies with L.A. Rule 66 and VOC/VOS Rules and Regulations.

1.02 PERFORMANCE REQUIREMENTS

A. See manufacturer's technical data bulletin for specific material, cured coatings and a complete list of chemical resistant properties.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product data, including physical properties, chemical resistance, surface preparation and application instructions. Include full range of color samples.

B. Submit list of five projects similar in nature, which have been installed by applicator during the last five years, identified with project name, location, name of owner's representative, their phone number and date.

C. Submit manufacturer's and applicator's warranty.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Applicator shall have minimum five years experience applying special coating materials on similar type projects.
2. Applicator shall be one of the applicators listed or be pre-qualified by the Architect based on recent experience:

   TW Hicks
   Tim Hicks tim@twhicksinc.com
   (866) 841-3484

   Industrial Flooring Services
   Sharon Marlow – 214-349-7891

   Sika products (installed by Sika Certified installer)
   Contact Sika Rep Ryan Manchester 214.914.5564 for Sika approved installer

3. Applicator shall employ skilled mechanics to ensure highest quality workmanship. Materials to be applied by craftsman experienced in use of specified products.

4. Submit documentation of following minimum applicator qualifications
   a. Minimum five years commercial experience applying specified coatings.
   b. Minimum five successful projects of similar scope and complexity.

B. Pre-application Conference: Prior to making field samples and placing order for materials, the installer shall schedule a meeting with the Architect, Owner, General Contractor and manufacturer's representative to agree on methods and schedule for application.

C. Mock up: Finish shall be light to very light and as approved by Architect. Provide min 100 sf mock up in non conspicuous area such as Janitors closet or beneath area to receive carpet. Provide samples until approved. Once approved, leave in place as a standard of quality until epoxy work is approved and removal is authorized by Architect.

D. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of coating systems that contain volatile organic compounds (VOC).

E. Field Quality Control:

1. Installer shall request acceptance by Owner's Representative of each coat before applying succeeding coats.
2. Furnish and maintain at Project site following fully calibrated testing and inspection devices:
   a. Wet Mil Gauge
   b. Tooke Destructive Mil Gauge.
   c. Sling Psychrometer.
3. Initiate and maintain for duration of Project field quality control program using certified calibration and testing devices and to ensure conformance with application requirements.

F. Tests: Test concrete for moisture in accordance with ASTM D 4263.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in accordance with manufacturer’s instructions.

1. Store materials in dry, enclosed area with adequate protection from moisture.
2. Keep containers sealed until ready for use.
3. Storage Temperature: 650 F (180 C) and 900 F (320 C).

1.06 WARRANTY

A. Written manufacturer’s five-year warranty covering materials only. Applicator to provide two-year application warranty for installation and material replacement costs and shall cover delamination of flooring, and transfer of slab cracks through the epoxy.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products specified are manufactured by the Tnemec Company and are listed as a standard of quality only.

B. Products of the following conforming to specification requirements are acceptable:
   1. Tennant, Sika

2.02 MATERIALS

A. Decorative Quartz

   1. Percent Solids, 100 ASTM D2369
   2. Completely light stable over the normal life of the coating.

B. Primer: Tnemec Series 245 Ultra-Tread urethane cement applied at 3/16" thickness.

C. Resin for broadcast coats: Tnemec Series 222 Deco-Tread. A two-component polyamine epoxy.
   1. Volatile Organic Compound (VOC), ASTM D 3960
      a. 0.15 lb/gal or 18 g/L
   2. Tensile Strength, ASTM D638
      a. 2138 psi or (15.0 MPa)
         1. Impact, ASTM D 2794
      a. 160” pounds avg. direct impact.

D. Finish Coat: Tnemec 291 Series

E. Colors:

   1. Provide colors as indicated on the drawings and as selected from manufacture standard palette. Additionally, custom colors and blends may be an option if indicated on drawings. Final colors to be selected and approved with the submittal.

F. Cleaners and Related Products:

   1. Industrial Grease Remover:
      a. Manufacture’s recommended detergents to remove a variety of soilage prior to final completion.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Installer shall examine concrete surface to receive floor coating system. Notify the Contractor and Architect if surface is not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected, including all trench drains being rubbed smooth and ready for the floor coating. No birdbaths, ponding, pits, divets, or bumps will be accepted. Once Floor installer begins their work, they assume responsibility for the condition of the subsurface.

B. Allow concrete substrate to cure a minimum of 30 days.

C. CHECK FOR MOISTURE: Concrete must be dry before application of this floor coating material. Concrete moisture testing must occur. Calcium chloride testing or in-situ relative humidity testing is required. Readings must be below 3 pounds per 1,000 sq. ft., over a 24-hour period on the calcium chloride test or below 80% relative internal concrete humidity. Test methods can be purchase at www.astm.org, see ASTM F1869 or F2170, respectively or follow instructions from the suppliers of these tests. Contractor shall provide additional equipment or materials which may include a manufacture approved slab sealer, at no additional cost, as required, to meet allowable moisture levels

3.02 PREPARATION

A. Cleaning: Scrub with manufacturer's detergent and rinse with clean water to remove surface dirt, grease and oil. Fill all cracks as recommended by manufacture prior to installation of epoxy flooring. Shot-blast or mechanically abrade to remove laitance, curing compounds, hardeners, sealers and other contaminants and to provide surface profile. Large voids, bugholes, and other cavities should be filled with recommended filler or surface. (Reference SSPC-SP13, ICRI CSP3-5):

3.03 APPLICATION

B. Apply floor coating system in strict accordance with manufacturer's latest published instructions. The following is intended as a general guide for minimum application. Final proportions and amounts may vary depending on the final color and texture approved by the Owner and Architect to achieve a light texture.

1. Equipment: Squeegees, rollers, mechanical blower and funnel for quartz application, etc.
2. Coating: Tnemec Deco-Tread (or approved ECO-DFS Decorative Floor Solution by Tennant)
   a. Mix components together in accordance with manufacturer's instructions.
   b. Apply Tnemec Series 245 Ultra-Tread urethane cement applied at 3/16" thickness Allow coating to cure 12 hours at 75 degrees F (24 degrees C) and 50% relative humidity.
   c. Apply Tnemec Series 222 Deco-Tread at the rate of approximately 80 sq. ft./gal.
   d. Immediately broadcast Tnemec 222 Part C (ChromaQuartz) decorative quartz into the resin at the rate of one half (0.5) pounds per sq. ft.
   e. Allow coating to cure 12 hours at 75 degrees F (24 degrees C) and 50% relative humidity.
   f. Sweep and then vacuum the entire area to remove all excess quartz.
   g. Apply second coat Tnemec Series 222 Deco-Tread at 80 ft2 / gal.

h. Repeat steps e, f, and g.
i. Apply a grout coat of Tnemec Series 256 Excellathane applied at 134 to 267 ft2 / gal.

3. Finish Coat: Tnemec 291 Series
   a. Mix components together in accordance with manufacturer's instructions.
   b. Mix only enough material, which can be applied within 10 minutes.
   c. Apply Tnemec 291 Series as recommended by manufacturer.
   d. Allow coating to dry 2 hours at 75 degrees F (24 degrees C) and 50% relative humidity.
   e. If less texture is desired, additional coats shall be applied within 72 hours of applying the previous coat, or as recommended by the manufacturer. Thickness of each coat and number of coats will determine the texture. Texture shall match approved mock up and no additional payment will be considered for additional coats to achieve acceptable texture.
   f. Total thickness of this system: 1/4-inch nominal thickness.

4. Cove Base: Tnemec Series 222 Deco-Tread blended with Series 222 Part C (ChromaQuartz) to form a 6" rolled radius cove.
5. Seal all exposed perimeter joints along walls, storefront, and top of bases.
6. Comply with recommendations of product manufactured for dying time between succeeding coats.
7. All cracks must be identified as either moving or non-moving. All cracks 1/16" wide or greater must be routed-out into a V-shape and filled flush by using Series 206 Sub-Flex epoxy and primer, as required for the particular filling installations. Treat moving cracks as control joints as described under "Joints" below.
8. Make edges of coatings adjoining other materials clean and sharp with no overlapping. Work material into surface voids and hairline cracks.
9. For all areas to receive cove base, install stainless steel J-Strip at the specified height to receive top edge of coving.
10. Exposed Perimeters:
    a. All exposed perimeter edges of the broadcast overlay, including doorways, traffic aisle sides, drains, etc. must be saw cut. Areas that cannot be reached with the saw or are difficult to saw cut shall be chipped.
    b. Saw cut shall be a minimum of ¼" deep and ¼" wide.
    c. Prime saw cut areas with Tnemec Series 201 Epoxoprime.
    d. Install flooring so that it folds into saw cut.
       Joints:
       Expansion Joints:
       i. Install flooring so that it covers the expansion joint.
       ii. After the floor system is installed, honor existing expansion joint by saw cutting a new ¼" x ¼" joint over the existing. Install closed cell polyethylene backer rod into saw cut approximately ½" to ¾" down into expansion joint, as required.
       iii. Fill saw cut with flexible polyurethane joint sealant designed for expansion joints.
    e. Control Joints:
       i. Fill all other recessed joints with Tnemec Series 201 Epoxoprime blended with fumed silica or Tnemec Series 215 Surfacing Epoxy. When filled, joint should be flush with the floor surface.
11. Rolled Radius Coving:
    a. Install coves prior to the installation of special flooring.
    b. Apply a prime coat of Tnemec Series 201 to all surfaces scheduled to receive coving.
    c. Install cove flush with the outer edge of the J-Strip.
    d. Apply coving sealant bead to top of J-Strip and tool flush to provide a smooth and uniform appearance, as indicated on the Drawings.
    e. Cut coves as required for joints.

3.04 PROTECTION

A. Close job site to traffic for a period of up to 48 hours after coating application depending on temperature and humidity. Provide additional protection from all construction traffic until substantial completion with plastic and plywood with all seams taped. Coordinate exact protection with Resinous floor manufacture to prevent damage to floor sealer and top coat.

3.05 REPAINTING

A. Refinish all work which has become damaged or defaced during construction and eave all finishing in clean, neat and perfect condition, acceptable to the Owner's Representative. Replace all broken glass and damaged material directly attributable to work under this Section.

3.06 ACCEPTANCE

A. Final acceptance of coatings shall be based upon inspection by the Owner's Representative. Coatings falling below specified and/or scheduled finish and shad shall be redone as required without expense to the Owner.

END OF SECTION

SECTION 09 90 00
Pipe and Equipment Painting

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Furnish all labor, materials, tools and equipment required for painting of structures, piping and equipment which are to receive finish as indicated in the schedule.

1.02 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.03 SUBMITTALS:

A. Submit manufacturer's product data.

B. Submit samples of finish for approval by Engineer.

1.04 DELIVERY, STORAGE AND HANDLING:

A. Deliver paint materials in sealed original labeled containers bearing manufacturers name, type of paint, brand name, color designation and instructions for mixing.

B. Provide adequate storage facilities at minimum ambient temperature of minimum 45° F to a maximum of 90° F in well ventilated area.

1.05 ENVIRONMENTAL REQUIREMENTS:

A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and systems can be applied.

B. Do not apply finish in areas where dust is being generated.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. All paint shall be of the best quality applied in strict conformity with the manufacturer’s recommendations, but not less than specified herein. Products of

the Tnemec Co. and Sherwin-Williams, which are acceptable for the various specific uses are tabulated following to establish a standard of quality. Comparable products of Valspar, Koppers Co., or other installations will be given equal considerations upon submittal and approval of written evidence of equivalence.

2.02 MATERIALS:

A. Whenever a material is identified by reference to manufacturer's or vendors' names, trade names, catalog number or the like, it is so identified for the purpose of establishing a standard, and material of other manufacturers or vendors which will perform adequately the duties imposed by the general design will be considered acceptable provided the material so proposed is substituted under provisions of the General Provisions. It shall not be purchased or installed by the Contractor without the Engineer’s written approval.

2.03 COLORS:

A. The Contractor shall submit for approval samples of each color and finish, with the name of the manufacturer made on the same materials on which each is to be used. Approved samples will form a standard for acceptance or rejection of completed work as to color and finish. Most colors will be the inter-mixes and let downs. Mix paints as required to obtain the color scheduled.

PART 3 EXECUTION

3.01 INSPECTION:

A. Thoroughly examine surfaces scheduled to be painted prior to commencement of work.

B. The application of finishes shall be held to denote the acceptance of surfaces and conditions by the painter and he will be responsible for producing results reasonably to be expected under the specifications. Rooms shall be swept out before application of paint, and no sweeping shall be done in or adjacent to places where the paint has not had sufficient time to dry dust-free.

3.02 INSPECTION DEVICES:

A. The Contractor shall furnish, until final acceptance of coating and painting, inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of coating and paint. The Contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of dry-film thickness gauge and

certified instrumentation to test accuracy of holiday detectors. Dry-film thickness gauges and holiday detectors thus required shall be made available for the Owner's Project Representative's

3.03 SURFACE PREPARATION:

A. All metal surfaces to be painted shall be sound, clean and free of mill scale, rust, dust, dirt, oil, grease, moisture or any other foreign matter which might, in any way, lessen the life or usefulness of the coating.

B. All metal surfaces shall be washed with mineral spirits to remove any dirt or grease, before applying materials. Where rust or scale is present, it shall be wire brushed, or sandpapered clean before painting. Shop coats of paint that become marred shall be cleaned and touched up.

C. Metal shall also be smooth and free from blisters, rough corners, pits, dents, or other imperfections before painting. Pits and dents shall be filled and the metal ground smooth where required.

D. When called for in the specifications or recommended by the paint manufacturer, the latest revisions of the following surface preparation specifications of the Steel Structures Painting Council shall apply:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.

2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wire brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders.

4. White Metal Blast Cleaning (SSPC-SP5): Blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.

5. Commercial Blast cleaning (SSPC-SP6): Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues from each square inch.

6. Brush-Off blast Cleaning (SSPC-SP7): Blast cleaning to remove loose rust, loose mill scale and other detrimental foreign matter to degree specified.

7. Near White Blast Cleaning (SSPC-SP10): Blast cleaning to nearly white metal cleanliness, until at least 95 percent of each element of surface area is free of all visible residues from each square inch.

3.04 APPLICATION:

A. All work shall be done by skilled mechanics. All materials shall be evenly spread and smoothly flowed on without sags or runs, and all coats shall be thoroughly dry per the manufacturer data sheet before applying succeeding coats.

B. Finish applied metal shall be sanded between coats with fine sandpaper to produce an even, smooth finish.

C. No exterior painting shall be done in rainy, damp, or frosty weather per the manufacturer data sheet or until the surface is thoroughly dry. No interior painting or finishing shall be permitted until the building has thoroughly dried out by natural or artificial heat.

D. The priming coat on interior walls shall be tinted to the approximate shade of the finish coat.

E. When two coats of coating or paint are specified, where possible, the two coats must be of contrasting color. Film thickness per coat as shown in the schedule following are minimum required. Contractor shall apply additional coats as necessary to achieve the specified thickness.

F. Paints and similar materials shall be mixed in vessels of adequate capacity. All paints shall be thoroughly stirred before being taken from the containers, shall be kept stirred while using, and all ready-mixed paints shall be applied exactly from the manufacturer without addition of any kind of a drier or thinner, except as provided in manufacturer's directions or upon specific authorization.

G. Mixing, thinning and application of the coating materials shall be in exact accordance with the manufacturer's recommendations.

H. Splitting paint kits and mixing of partial kits is not allowed. Mix only whole kits and discard any left-over paint.

3.05 MECHANICAL ELECTRICAL EQUIPMENT:

A. Refer to mechanical and electrical sections with respect to color coding identification banding of equipment, ducting, piping and conduit.

B. Remove grilles, covers, and access panels for mechanical and electrical systems

from location and paint separately.

C. Finish paint primed equipment to color selected.

D. Prime and paint exposed insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars and supports, except where items are plated or covered with a pre-finished coating.

E. Replace identification markings on mechanical or electrical equipment when painted over or spattered.

F. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

3.06 HARDWARE:

A. Remove all hardware and electric plates and thoroughly protect same before painting, as he will be held responsible for any paint spots or staining and will be required to replace same, if damaged by painting or staining.

3.07 CLEANING:

A. Use drip cloths to protect floors and adjacent finishes while working. Upon completion, this Contractor shall clean off all paint spots and stains caused by him upon floors, glass and woodwork.

3.08 TOUCHING UP:

A. On completion, carefully touch up any holidays, marred or damaged spots, and work over all surfaces that have been repaired by other trades.

3.09 PAINTING AND FINISHING SCHEDULE:

A. The number of coats called for in this schedule shall be considered minimum. If more coats are required for complete coverage and uniform appearance, they shall be applied. Colors will be selected by the Owner from standard manufacturer's color samples.

PAINTING SCHEDULE

Schedule A – Ductile Iron or Cast Iron Above Ground Valves, Pipes, and Fittings

Exposure Condition: Non Submerged
Surface Preparation: Abrasive blast clean in accordance with NAPF 500-003

Painting System:	1st Coat	- 3.0 – 5.0 dry mils of Tnemec Series N69 Hi-Build Epoxoline II or 4.0 – 5.0 dry mils of Sherwin-Williams DTM Acrylic Primer/Finish @ the rate of 290 sq.ft./gal.
	2nd Coat	- 4.0 – 6.0 dry mils of Tnemec Series N69 Hi-Build Epoxoline II or 3.0 – 4.0 dry mils of Sherwin-Williams DTM Acrylic Coating @ the rate of 250 sq.ft./gal.
	3rd Coat	- Tnemec only: 2.0 – 3.0 dry mils of Tnemec Series 73, 1074 or 1075 Endura-Shield

Schedule B – Ferrous Metals at or Below Water Surfaces

Exposure Condition: Submerged

Surface Preparation: Prior to abrasive blast cleaning: Remove any existing coatings, rust and weld splatter. Weld flux and splatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard SP0178, Designation D. SSPC-SP10 Near-White Metal Blast Cleaning followed by SSPC-SP1 Solvent Cleaning. Anchor profile shall be 3.0 mils as per ASTM D 4417, Method C or NACE Standard RP0287.

Painting System:	1st Coat	- 2.5 – 3.5 dry mils of Tnemec Series 1 Omnithane or 8.0 – 12.0 mils of ChestertonARC S1
	2nd Coat	- 6.0 – 8.0 dry mils of Tnemec Series 446 Perma-Shield MCU or 8.0 – 12.0 mils of Chesterton ARC S1
	3rd Coat	- 6.0 – 8.0 dry mils of Tnemec Series 446 Perma-Shield MCU

Notes: The coating environment is humid and corrosive. Coatings shall be applied on the same day as the abrasive cleaning. Any rust, evidence of corrosion, or discoloration appearing after abrasive blast and before application of the coating shall be removed by abrasive blasting or power tool cleaning. The CONTRACTOR shall have the OWNER's Representative inspect the surface after preparation and prior to application of the first coat. Coatings on new equipment shall have the first coat applied at the manufacturer's facility.

END OF SECTION

09 96 00
HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Coating systems for wastewater processing facilities.

1.02 RELATED SECTIONS

A. Section 01 33 00 Submittal Procedures.

B. Section 08 11 13 Hollow Metal Doors and Frames

C. Section 09 20 00 Plaster and Gypsum Board

1.03 REFERENCES

A. ASTM D 16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.

B. ASTM D 4263 - Indicating Moisture in Concrete by the Plastic Sheet Method.

C. ASTM F 1869 - Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

D. AWWA D 102- Painting Steel Water Storage Tanks

E. International Concrete Repair Institute (ICRI) Guideline No. 310.2-1997 (formerly 03732) - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

F. NACE SP0188 - Standard Recommended Practice, Discontinuity (Holiday) Testing of Protective Coatings.

G. NAPF 500-03-04 Abrasive Blast Cleaning.

H. SSPC-SP 1 - Solvent Cleaning.

I. SPPC-SP 5/NACE 1 - White Metal Blast Cleaning

J. SSPC-SP 6/NACE 3 - Commercial Blast Cleaning.

K. SSPC-SP 10/NACE 2 - Near-White Metal Blast Cleaning.

L. SSPC-SP 16 Brush-Off Blast Cleaning of Non-Ferrous Metals

M. SSPC-SP 13/NACE 6 - Surface Preparation of Concrete.

N. SSPC-TU 11 - Inspection of Fluorescent Coating System

1.04 DEFINITIONS

A. Definitions of Painting Terms: ASTM D 16, unless otherwise specified.

B. Dry Film Thickness (DFT): Thickness of a coat of cured paint measured in mils (1/1000 inch).

1.05 SUBMITTALS

A. Comply with Section 01 33 00 Submittal Procedures.

B. Product Data: Submit manufacturer's product data for each coating, including generic description, complete technical data, surface preparation, and application instructions.

C. Color Samples: Submit manufacturer's color samples showing full range of standard colors.

D. Manufacturer's Quality Assurance: Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.

E. Applicator's Quality Assurance: Submit list of a minimum of 5 completed projects of similar size and complexity to this Work. Include for each project:

1. Project name and location.
2. Name of owner.
3. Name of contractor.
4. Name of engineer.
5. Name of coating manufacturer.
6. Approximate area of coatings applied.
7. Date of completion.

F. Warranty: Submit manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Specialize in manufacture of coatings with a proven successful experience.

2. Able to demonstrate successful performance on comparable projects.
3. Single Source Responsibility: Coatings and coating application reducers and additives shall be products of a single manufacturer.

B. Applicator's Qualifications:

1. Experienced in application of specified coatings on projects of similar size and complexity to this Work.
2. Applicator's Personnel: Employ persons trained for application of specified coatings.

C. Preapplication Meeting: Convene a preapplication meeting two [2] weeks before start of application of coating systems. Require attendance of parties directly affecting work of this section, including Contractor, Engineer, applicator, and manufacturer's representative. Review the following:

1. Environmental requirements.
2. Protection of surfaces not scheduled to be coated.
3. Surface preparation.
4. Application.
5. Repair.
6. Field quality control.
7. Cleaning.
8. Protection of coating systems.
9. One-year inspection.
10. Coordination with other work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:

1. Coating or material name.
2. Manufacturer.
3. Color name and number.
4. Batch or lot number.
5. Date of manufacture.

6. Mixing and thinning instructions.

B. Storage:

1. Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions.
2. Keep containers sealed until ready for use.
3. Do not use materials beyond manufacturer's shelf life limits.

C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Weather:

1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
5. Wind: Do not spray coatings if wind velocity is above manufacturer's limit.
6. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D 102.

B. Dust and Contaminants:

1. Schedule coating work to avoid excessive dust and airborne contaminants.
2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.08 EXTERIOR PAINTING EXHIBIT

A. Contractor to paint all visible portions and components of the existing structures included in the painting exhibit. The portion of work are located on the exterior of the Belt Press Building, Sludge Building, Admin Building, Misc. Building, Storage Shed, and the interior and exterior Chlorine Shelter structure.

B. Contractor shall prepare surface for paint in accordance with manufacture requirements. Contractor to field verify existing site conditions present prior to starting work.

C. The portions to be painted are for all visible portions of the building including but not limited to the conduit, metal panels, metal soffits, metal bars/grates, door frames, doors, window frames, downspouts, roof soffits, CMU, steel structure and ducts.

D. All dimensions attached in the exhibit are approximate. The contractor shall verify dimensions prior to starting work.

E. The main paint shall be Sherwin Williams SW 9170 Acier and shall include all surfaces not listed in accent paint.

F. All accent paint shall be painted Sherwin Williams SW 7019 Gauntlet Gray, and shall include doors, door frames, window frames, soffits, and fascia.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Products specified are manufactured by Sherwin Williams and United States Gypsum (Joint Treatment) and are listed as a standard of quality only.

B. Products of PPG, Glidden Professional, and Benjamin Moore, conforming to specification requirements are acceptable if the color matches what was specified or scheduled.

C. Substitutions: Under provisions of the general Provisions.

2.02 COATING SYSTEMS FOR STEEL - STRUCTURAL, TANKS, PIPE, EQUIPMENT, AND MISCELLANEOUS

A. Exterior Exposed:

1. System Type: Epoxy*/epoxy/urethane.
2. Surface Preparation: SSPC-SP 6 with a surface profile of 2.0 to 3.0 mils.
3. Primer*: Macropoxy 646. DFT 3.0 to 5.0 mils.
4. Intermediate Coat: Macropoxy 646. DFT 3.0 to 5.0 mils.

5. Finish Coat: Acrolon Ultra DFT 2.0 to 4.0 mils.
6. Total DFT: 8.0 to 14.0 mils.
7. Finish Color: As indicated on the drawings.
8. Macropoxy 5500 and Corothane I Galvapac Zinc Primer are also acceptable.

2.03 COATING SYSTEMS FOR GALVANIZED STEEL AND NONFERROUS METAL - PIPE AND MISCELLANEOUS FABRICATIONS

A. Exterior Exposed:
   1. System Type: Epoxy/urethane.
   2. Surface Preparation: SSPC SP 16.
   3. Primer: Macropoxy 646. DFT 3.0 to 5.0 mils.
   4. Finish Coat: Acrolon Ultra. DFT 2.0 to 4.0 mils.
   5. Total DFT: 5.0 to 9.0 mils.
   6. Finish Color: As indicated on the drawings, or color schedule.

2.04 ACCESSORIES

A. Coating Application Accessories:
   1. Accessories required for application of specified coatings in accordance with manufacturer's instructions, including thinners.
   2. Products of coating manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which coating systems are to be applied. Notify Architect of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.02 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.

B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.03 SURFACE PREPARATION OF STEEL

A. Prepare steel surfaces in accordance with manufacturer's instructions.

B. Fabrication Defects:

1. Correct steel and fabrication defects revealed by surface preparation.
2. Remove weld spatter and slag.
3. Round sharp edges and corners of welds to a smooth contour.
4. Smooth weld undercuts and recesses.
5. Grind down porous welds to pinhole-free metal.
6. Remove weld flux from surface.

C. Ensure surfaces are dry.

D. Immersion or Below Grade Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2. Create a surface profile as specified in Part 2 or as required by the coating manufacturer..

E. Exterior Exposed or Interior Exposed Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3. Create a surface profile as specified in Part 2 or as required by the coating manufacturer..

F. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.

G. Shop Primer: Shop primed steel shall receive a field sweep blast prior to the application of subsequent coats. Prepare shop primer to receive field coat in accordance with manufacturer's instructions. Removal all unknown shop primers and re-prime in accordance with this specification.

3.04 SURFACE PREPARATION OF GALVANIZED STEEL AND NONFERROUS METAL

A. Prepare galvanized steel and nonferrous metal surfaces in accordance with SSPC-SP16 and the coating manufacturer's instructions.

B. Test galvanized surfaces for chromate treatments and remove as required by SSPC-SP 16, or other Engineer approved method.

C. Ensure surfaces are dry.

3.05 SURFACE PREPARATION OF DUCTILE OR CAST IRON

A. Prepare ductile or cast iron surfaces in accordance with NAPF 500-03-04 Abrasive Blast Cleaning with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxide may remain. Bituminous coated pipe shall NOT be allow if field painting is required.

B. Bituminous coated pipe shall NOT be allow if field painting is required.

C. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.06 APPLICATION

A. Apply coatings in accordance with manufacturer's instructions.

B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.

C. Keep containers closed when not in use to avoid contamination.

D. Do not use mixed coatings beyond pot life limits.

E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.

F. Uniformly apply coatings at spreading rate required to achieve specified DFT.

G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.

H. Stripe paint with brush critical locations on steel such as welds, corners, and edges using specified primer. Apply and additional strip coat of the intermediate coating material in immersion areas.

I. Roll or backroll the first coat of epoxy or block filler applied to concrete or interior block substrates to work the material into the substrate.

3.07 REPAIR

A. Materials and Surfaces Not Scheduled To Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.

B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.

C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.08 FIELD QUALITY CONTROL

A. Required Inspections and Documentation:

1. Verify coatings and other materials are as specified.
2. Verify environmental conditions are as specified.
3. Verify surface preparation and application are as specified.
4. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges. DFT's shall be measured in accordance with SSPC-PA2.
5. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.

A. Check for holidays on interior steel immersion surfaces using holiday detector in accordance with NACE SP0188 or SSPC TU-11 using a safe blue light inspection lamps if OAP technology is used.

6. Report:

B. Prepare inspection reports daily.

C. b. Submit written reports describing inspections made and actions taken to correct nonconforming work.

D. c. Report nonconforming work not corrected.

E. d. Submit copies of report to Engineer and Contractor.

B. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems.

3.09 CLEANING

A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.10 PROTECTION OF COATING SYSTEMS

A. Protect surfaces of coating systems from damage during construction.

3.11 ONE-YEAR INSPECTION

A. Owner will set date for one-year inspection of coating systems.

B. Inspection shall be attended by Owner, Contractor, Engineer, and manufacturer's representative.

C. Repair deficiencies in coating systems as determined by Engineer in accordance with manufacturers instructions.

END OF SECTION

SECTION 10 00 00
MISCELLANEOUS ACCESSORIES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Magnetic Marker Boards
B. Fire Extinguisher and Cabinets
C. Lockers
D. Boot and Shoe Scraper / Brush
E. Bench (Shower room)
F. Building Letters
G. Exterior Handrail

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each item.

PART 2 – PRODUCTS

2.01 PRODUCTS AND MANUFACTURER

A. **Magnetic Marker Boards:** Furnish and install 4’ H x 5’ L (unless otherwise specifically indicated on drawings) “LCS Elite Porcelain Whiteboard” frameless magnetic dry erase marker boards installed as recommended by manufacturer. Contractor to provide magnetic accessory tray with each magnetic marker board for a complete system. Marker boards and accessories mfg. by CLARIDGE. Color of marker board and accessory as selected by owner from standard color. Locate as indicated on interior elevations (field verify exact location with Architect / Owner prior to installation).

B. Fire Extinguishers and Cabinets

1. FE (Multi-Purpose Dry Chemical): Model MP5 manufactured by Larson’s: 5 lbs capacity and UL rated 2A-10B:C. Extinguishers shall be fully charged and ready for use. Locate as indicated on the plans or at a max. 75’ distance.
2. For each fire extinguisher Type FEC, provide Larsen’s Architectural Series, model number 24095R with Break Glass door fire extinguisher cabinet, semi recessed. Door and trim shall be fabricated from cold-rolled steel with white baked acrylic enamel finish. Max projection from wall is 3 ½”. Provide standard mounting bracket for type FE.

3. All doors shall be keyed alike.

C. **Lockers:** Furnish and Install heavy duty, two tier lockers 15”w x 18”d x 72”h with ventilating doors in quantities indicated on the drawings. Features: Quiet locking, device recessed handles, coat hooks, slide lock to receive padlock, number plates, 16 ga. Body and doorframes, 14 ga.door. Tops shall have continuous sloping top with hood ends. Provide end caps, filler strips at inside corners, and a 12 ga. Continuous min 4“-high base, number plates, and closure trim piece between lockers and adjacent walls. See floor plans for locations. Provide minimum 5% accessible lockers with accessible reach range and hardware, including one-touch spring latch or u-shaped pulls, and key locks in lieu of combination. Color to be selected from mfr standard colors. Lockers shall comply with current TAS requirements. Contractor shall order in time to avoid delay to completion of the project.

D. **Boot and Shoe Scraper:** Equal to Scrusher Deluxe Scrusher Boot cleaner. Featuring three brushes on the bottom of stiff nylon, weather resistant UV powder coated finish, durable steel frame, hard maple replaceable brushes, side bristles made of soft poly (so shoes don’t scratch), elevated base for cleaning ease. Locate as noted on drawings. Exact location to be confirmed with Owner, however location to be outside of accessibility code required door clearances.

E. **Bench:** Salsbury Industries. As indicated on plans. 42"W x 20”D x 18”H bench model 77781-ADA butcher block bench with dark wood finish available at lockers.com. Coordinate exact mounting directions with manufacturer .

F. **Building Letters:** shall be equal to “Southwell” HELVETICA style with factory applied baked enamel paint over cast aluminum. Colors as selected from manufacturers standards. All caps. Letters shall be sized as indicated on drawings, min. 2” deep and anchored with concealed threaded bolts. Letters are to be reverse channel. See drawings for exact wording and sizes. City’s logo to not be created from a font, but from the City logo. Provide full size template on building for architect approval of spacing prior to installing.

G. **Exterior Handrail**: shall be a wall-mounted prefinished aluminum handrail and mounting brackets with anodized finish. Colors as selected from manufacturers standards. Refer to exterior elevations for location. Handrail shall meet TAS/TDLR standards which include but not limited to a wall thickness not less than 18 (0.50”) gauge, clearance between wall surface and inside face of bar of 1 1/2”, a gripping surface shall have an outside diameter between 1 1/4” to 2”, and have a gripping surface that is not obstructed for more than 20 percent of their length and projections shall occur 1 1/2” minimum below the bottom of the gripping surface. Contractor to refer to TAS guidelines for all requirements. Coordinate exact mounting directions with manufacturer.

END OF SECTION

SECTION 10 14 00
PLASTIC SIGNS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.02 SCOPE

A. Furnish all material, labor and engineering services necessary to program facility and to fabricate and install signage including vinyl lettering / numbers as required by Fire Department and local authorities.

1.03 RELATED SECTIONS

A. Section 10 00 00 – Building Signage.

B. Division 23 – Mechanical Identification.

C. Division 26 – Electrical Identification.

1.04 REFERENCES

A. Signs and their installation shall comply with applicable provisions of the latest edition of the following standards and with requirements of authorities having jurisdiction:

1. ADAAG – Americans with Disabilities Act Accessibility Guidelines; US Architectural and Transportation Barriers Compliance Board.

2. International Code Council/American National Standards Institute A117.1-Standard on Accessible and Usable Buildings Facilities.

3. Texas Accessibility Standards of the Architectural Business Act Article 9102 Texas Civil Statutes.

4. National Fire Protection Association 101 Life Safety Code.

1.05 SUBMITTALS

A. Signage schedule in manufacturer's format for verification of text/copy.

B. Approval drawings showing materials, construction detail, lay-out, copy, size and mounting methods.

C. Sample of two sign types for verification of materials, color, pattern, overall quality, and for adherence to drawings and requirements indicated.

1.06 QUALIFICATIONS

A. Manufacturer specializing in manufacturing the products specified in this section with minimum five years experience. Obtain signs from one source and a single manufacturer.

1.07 WARRANTY

A. Provide manufacturer's warranty against defects in materials or workmanship for minimum 5 years.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Signage shall be Vivid Image intense signage as manufactured by Takeform Architectural Graphics, One Mahar Way, Medina, NY 14103, 1.800.528.1398 Local rep is David Esh, senior account manager, 214.412.4446 dle@takeform.net

Or Architect approved equal

B. Substitutions: As indicated under provisions of Section 01 60 00 – Product Requirements and within the allowable time frame indicated.

2.02 SIGN STANDARDS

A. Typography

1. Type style: see drawings. Copy shall be a true, clean, accurate reproduction of typeface(s) specified. Upper and lower case or all caps as indicated in Sign Type drawings and Signage Schedule. Letter spacing to be normal and interline spacing shall be set by manufacturer.

2. Arrows, symbols and logo art: To be provided in style, sizes, colors and spacing as shown in drawings.

3. Grade II Braille utilizing perfectly round, clear insertion beads.

B. Color and Finishes

1. Typography: To be selected from manufacture's standards.

2. Message Background: as indicated on the Floor Plan. Confirm actual wording and spelling of each sign with architect during submittals.

3. Finishes are to meet current Federal ADA and any State requirements.

2.03 SIGNS

A. Architectural Signage System

1. The signage shall incorporate a decorative laminate face with applied graphics including all tactile requirements in adherence to ADA specifications.

2. All signs, including workstation and room ID's, overheads and flag mounts, directionals and directories shall have a matching appearance and constructed utilizing the same manufacturing process to assure a consistent look throughout.

B. Materials

1. Sign face shall be 0.035" (nominal) standard grade, high pressure surface laminate. A painted sign face shall not be acceptable.

2. The substrate shall be Green 209, a natural fiber wood product with SFI certification. The sign shall incorporate balanced construction with the core sandwiched between laminates to prevent warping. An acrylic substrate shall not be acceptable. Laminate on the sign face only shall not be acceptable.

3. Tactile lettering shall be precision machined, raised 1/32", matte PETG and subsurface colored for scratch resistance.

4. Signs shall incorporate a metal accent bar. Bars shall be anodized with a brushed satin finish. Painted bars shall not be acceptable.

5. Sign and backer edge shall be treated with a hot wax seal for moisture integrity.

C. Standard Colors

1. Face/background color shall be standard grade, high pressure laminate, all colors and finishes.

2. Standard tactile colors shall match manufacturer's ADA standard color selection.

D. Construction

1. The signage shall be capable of accepting paper or acetate inserts to allow changing and updating as required. Insert components shall have a 0.080” thickness non-glare acrylic window and shall be inlayed flush to sign face for a smooth, seamless appearance.

2. The signage shall, with the exception of directories and directionals, be a uniform 8½" width to facilitate inserts printed on standard width paper.

3. The signage contractor shall provide and install all signage inserts and provide software templates to Owner as part of close-out documents.

4. Manufacturer shall provide a template containing layout, font, color, artwork and trim lines to allow Owner to produce inserts on laser or ink jet printer. The template shall be in an Acrobat or Word format (.pdf).

5. The signage shall include modules allowing for inserts, notice holders, occupancy sliders, marker, magnetic, and cork pin boards. All modules shall be flush to sign face for a smooth, seamless appearance.

6. The laminates (front and back) shall be pressure laminated and precision machined together to a 90-degree angle. Edges shall be smooth, void of chips, burrs, sharp edges and marks.

7. The signage shall utilize an acrylic sphere for Grade II Braille inserted directly into a scratch resistant, high pressure laminate sign face. Braille dots are to be pressure fit in high tolerance drilled holes.

8. Braille dots shall be half hemispherical domed and protruding a minimum 0.025".

9. The signage shall utilize a water based adhesive. The adhesive shall be nonhazardous and shall allow for flexing and deflection of the adhered components due to changes in temperature and moisture without bond failure.

10. All signs shall be provided with appropriate mounting hardware. Hardware shall be finished and architectural in appearance and suitable for the mounting surface.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install signs after doors and surfaces are finished, in locations scheduled.

C. Position sign 2 inches from latch side of door at 60" A.F.F. to center of sign, in compliance with accessibility standards.

D. Locate sign on wall surface, level.

E. Installer to conduct a pre-installation survey prior to manufacturing to verify message schedule copy and sign location. Each location shall be noted using low tack vinyl. Full scale renderings of directions and directionals shall also be provided. Any location discrepancy or message issues shall be submitted to architect for review.

F. Signs shall be level, plumb, and at heights indicated with sign surfaces free from defects.

G. If any signs are placed on transparent surfaces such as a sidelight, provide a corresponding laminate back on one side to conceal adhesive mounting strips.

H. Upon completion of the work, signage contractor shall remove unused or discarded materials, containers and debris from the site.

3.03 SCHEDULES

A. Provide signage at all toilet rooms.
   a. Provide signage at each room indicated on the Floor Plan.
   b. Locate one sign at each door opening to the space.
   c. Provide matching backing material on inside of rooms with glass sidelites where the back of the sign is visible inside the room.

B. Provide exterior grade signage (painted stenciled or vinyl lettering) in accordance with the local Fire Marshal requirements for fire riser equipment, FDC,, and other related required locations including stenciled address on entry doors – sized and located as required by FD.

C. Confirm actual wording and spelling of each sign with Owner / architect during submittals.

3.04 STANDARDS MANUAL

A. Manufacturer shall provide a comprehensive Standards Manual in both a paper and PDF format. The manual shall include all renderings, drawings, location plan, message schedule, insert templates, mounting detail, and reorder information.

END OF SECTION

SECTION 10 14 00
SIGNAGE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install signage as shown, as scheduled and specified herein.

B. Types to be furnished are as follows:

1. Restrictive/Caution Signs and Hazard Identification Signs.

1.2 SUBMITTALS

A. Submit to the Engineer for review the Manufacturer's complete color range and type styles.

B. Submit to the Engineer as provided in Section 01 33 23 shop drawings and product data showing details of construction, electrical work, where required, and erection details.

C. Submit sign layouts for review as follows:

1. Scale layout of all exterior building signs.

2. Submit to the Engineer for review cleaning and maintenance instructions for all signage components.

1.3 REFERENCES

A. National Fire Protection Association (NFPA)

1. NFPA 49 - Hazardous Chemicals Data

2. NFPA 325M - Properties of Flammable Liquid, Gases, and Volatile Solids

3. NFPA 704 - Identification of Fire Hazards of Materials

B. Occupational Safety and Health Act (OSHA)

PART 2 - PRODUCTS

2.1 MATERIALS

A. Signs shall be manufactured by Accuform (Brooksville, FL) or approved equal.

B. All lettering shall be Helvetica Medium, sized and in both upper and lower case, as specified and scheduled.

C. Restrictive/Caution Signs and Hazard Identification System shall be SPF constructed of 0.080-in vinyl laminated to a 0.080-in acrylic backing.

D. Letters or symbols shall be screen printing or ASP process both in subsurface locations.

E. Restrictive/Caution Signs shall have 1-in radius rounded corners.

F. Color of acrylic and letters shall be in accordance with OSHA standards.

G. All other aspects of the Restrictive/Caution Sign shall be in accordance with OSHA standards.

Hazard identification system shall conform to National Fire Protection Association (NFPA) NFPA 704 with a large diamond shape made up of four smaller diamonds with numbers on the diamonds corresponding to the labels for the chemical represented. Small diamonds are to be 5-in on a side with 4-in letters. The overall diamond shall be 10-in on a side. The health diamond shall be blue with a white number. The flammability diamond shall be red with a white number. The Reactivity diamond shall be yellow with a blue number. The unusual reactivity diamond shall be white with a red symbol. Health diamond is on the left. Flammability diamond is on the top. Reactivity diamond is on the right. Special reactivity diamond is on the bottom. Reference for the contents of these signs for each chemical is NFPA 49. If OSHA standards do not apply, the color of the acrylic shall be red with white letters 1-in high. Signs shall be wall surface mounted continuous across sign with concealed fasteners. Other means of fastening may be used on fences and other unusual mounting locations such as tanks.

H. Signs shall be suitable for interior or exterior use.

2.2 EXTERIOR SIGNS

A. Exterior signs shall be made of thermosetting polyester resin reinforced with chopped glass fiber strands and fabricated in a 6-in, 8-in, or 12-in profile seamless construction depending upon the standard design that is reinforced to eliminate cupping and warping plus withstand a 50-psf windload. Graphics shall be subsurface, integral with the molded sign face structure, protected with a polyurethane resign coating system containing ultraviolet inhibitors, and using Helvetica Regular upper and lower case letters as detailed on the Sign Schedule. Medium bronze or blue letters and arrows on a tan background shall be used for the site signs as scheduled with blue noted and all other medium bronze. Lettering shall appear on both faces of the signs indicated in the schedule by sides marked "a" and "b." Size shall be as scheduled for the plant sign and site signs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Signage shall be installed at the locations described in the specifications, shown on the Drawings, or as directed, in accordance with the Manufacturers' recommendations and shop drawings.

B. Damaged items shall be removed and replaced at no cost to the Owner.

C. Signage shall be cleaned to the satisfaction of the Engineer using the approved methods, and upon completion of the installation and again, just prior to acceptance of the project.

D. Restrictive Signs

Quantity	Sign Text	Location	Colors	Height (inch)	Width (inch)
2	CITY OF WEST UNIVERSITY PLACE, TEXAS WASTEWATER TREATMENT PLANT FOR PLANT INFORMATION OR TOURS (713) 662-5839	Near Exterior Gates	Black Text White Background Black Border	20	30
2	DANGER CHLORINE	Near Exterior Gates and Disinfection Tanks	Red Danger Oval with White Text Black Text White Background Black Border	10	14
2	DANGER NO TRESPASSING	Near Exterior Gates	Red Danger Oval with White Text Black Text White Background Black Border	10	14
2	DANGER HIGH VOLTAGE	Near Exterior Gates	Red Danger Oval with White Text White Background Black Border	10	14
2	DANGER OPEN TANKS	Near Exterior Gates	Red Danger Oval with White Text White Background Black Border	10	14
5	EMERGENCY EYE WASH STATION	Near Exterior Gates And at each eye wash station	White Text Green Background White Border	10	14
2	See TCEQ Text below	Near Exterior Gates	See TCEQ website below.	25	20

3.2 TCEQ TEXT:

A. Use the following text:

WARNING!

Public Water System

TAMPERING WITH THIS FACILITY IS A FEDERAL OFFENSE!!!

INDIVIDUALS WHO ILLEGALLY ENTER, TAMPER, OR THREATEN TO DO EITHER WILL BE

PROSECUTED TO THE FULLEST EXTENT OF THE LAW!

FEDERAL STATUTE (42 USC 300i-1)

MAXIMUM PENALTY UP TO 20 YEARS PRISON TERM

MAXIMUM FINE UP TO $1 MILLION

TEXAS STATUTE {5 TPC 22.07(a)(4)} and {7 TPC 28.03(a)(1), (2), & (3)}

MAXIMUM PENALTY UP TO 10 YEARS PRISON TERM

MAXIMUM FINE UP TO $10,000

To Report Suspicious Behavior:

Call 911 immediately and notify the Texas Commission on Environmental Quality at 888-777-3186

B. TCEQ website: See https://www.tceq.texas.gov/assistance/water/pdws/sign-template-for-public-water-systems for colors.

END OF SECTION

SECTION 10 14 16
PLAQUES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to the work of this section.

1.02 WORK INCLUDED

A. Furnish all labor, material and equipment required to furnish and install plaques described herein and as shown on drawings.

1.03 RELATED WORK

A. Section 10441 – Plastic Signs.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01300.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. Products as specified are by the Southwell Company and are listed as a standard of quality.

B. Substitutions: As per Section 01300.

2.02 PLAQUE

A. Brushed Aluminum faced raised Helvetica style letters on black textured background with raised perimeter border. Refer to drawings for details.

B. Chemically cleaned and etched with alodine.

C. Two coats of clear acrylic lacquer.

D. Mounting to wall as per manufacturer's recommendation for threaded concealed anchors.

E. Confirm completion date, as well as all names, titles and spelling with Owner prior to ordering.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Aluminum plaque shall be located as directed by the Architect and shall be set plumb, level and securely anchored in place.

END OF SECTION

SECTION 10 28 00
TOILET AND SHOWER ACCESSORIES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Extent of each type of toilet accessory is indicated on drawings and schedules.

B. Types of toilet accessories required include the following:

Recessed Paper towel dispenser waste receptacle.
Toilet tissue dispenser.
Grab bars.
Robe & Coat Hook.
Wall mirrors.
Soap dispenser.
Mist Deodorizers.
Shower Accessories.

1.03 RELATED WORK

A. Division 22 – Plumbing Fixtures

1.04 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in wall; coordinate delivery with other work to avoid delay.

B. Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units.

C. Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise acceptable to Architect.

D. All accessories as herein noted, or others as required by ADA shall be included and installed to ADA standards.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.

Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices and cut-out requirements in other work.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following:

Bobrick Washroom Equipment, Inc., and Bradley Washroom Equipment.

2.02 MATERIALS – GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22-gauge (0.34") minimum, unless otherwise indicated.

B. Brass: Leaded and unleaded, flat products, FS QQ-B-613; rods, shapes, forgings, and flat products with finished edges, FS QQ-B-626.

C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 20-gauge (0.40") minimum, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.

D. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

E. Mirror Glass: FS DD-G-451, Type I, Class 1, Quality q2, ¼" thick, with silver coating, copper protective coating, and non-metallic paint coating complying with FS DD-M-411.

F. Galvanized Steel Mounting Devices: ASTM A 153, hot dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

2.03 TOILET TISSUE DISPENSERS

A. Double-Roll Dispenser: Size to accommodate two separate rolls of core type tissue to 5" diameter.

B. Fabrication: Molded eccentric-shaped plastic spindle with die-cast, satin-finished aluminum bracket, designed for surface mounting. **NOTE**: spindle must be free to rotate.

2.04 RECESSED PAPER TOWEL DISPENSER / WASTE RECEPTACLE

A. Stainless Steel Satin Finish – Bobrick B-3803 (recessed in drywall). Install one adjacent to sink or lavatory in each toilet rooms or as indicated on drawings (field coordinate exact location in case of discrepancy).

2.05 GRAB BARS (Type, size and location per TDLR Accessibility requirements)

A. Product of Basis of Design: Bobrick grab bar B-5806.

B. Stainless Steel Type: Provide grab bars with wall thickness not less than 18 (.050") gauge.

C. Mounting: Concealed, manufacturer's standard flanges and anchorages.

D. Clearance: 1-1/2" clearance between wall surface and inside face of bar.

E. Gripping Surfaces: Smooth, satin finish.

F. Install bars in each H.C. stall.

2.06 SOAP DISPENSERS

Liquid Soap Dispenser, Horizontal Tank Type: Fabricate for surface mounting, sized for 40 fl. Oz. Minimum capacity. Provide stainless steel piston, springs, and internal **parts** designed to dispense soap in measured quantity by pump action. Provide cover type 304 stainless steel in #4 finish, with unbreakable window-type refill indicator. (Locate one over each lavatory. Equip unit with push type valve for dispensing soap in liquid form.

2.07 SANITARY NAPKIN DISPOSAL UNITS

Surface-mounted Type: Fabricate of stainless steel with seamless exposed walls, tightly self-closing top cover and locking bottom panel with continuous stainless-steel piano hinge. Install one per stall in each women's toilets.

2.08 MIRRORS

A. Fixed Wall Type 304 SS, ½" x ½" frame with ¼" float glass mirror. Size 18" x 36" or as indicated on the drawings - mount bottom of reflective surface at 40" above finish floor, install one above each lavatory and as indicated on drawings. Provide 24" x 60" size at Shower Room as indicated on drawings.

2.09 MIST DEODORIZERS

A. Mist deodorizers (located in each toilet room) should be Technical Concepts AutoFresh LCD Aerosol; TC400979BUND. Mount at 80" to bottom

2.10 SHOWER ACCESSORIES

A. Soap Dish and Bar: B681, bright polished, stainless steel.

B. Shower Grab Bar: B-6806x24 (side walls) and B6806x48 (rear wall), 1-1/2" diameter, peened grip, 18-gauge, stainless steel, concealed mounting, 1-1/2" wall clearance. Provide grab bars in full compliance with accessibility requirements (max 6" from back corners in

each direction).

C. Shower Curtain Rod: American Specialties, Inc. #1204 extra heavy duty with 1200-SHU hooks and 1200V-shower curtain – custom height approx. 80" with bar mounted to allow 1" max clearance beneath the curtain Notify architect if 1" max clearance doesn't work with 80" bar height prior to install. Provide at each shower opening and as indicated on drawings – for this project 1 shower

D. Commercial Robe & Coat Hook at 48" AFF provide 2 adjacent to each shower and as indicated on drawings at each toilet room. Bobrick B-76717, Stainless Steel

2.11 ROBE & COAT HOOK - Bobrick B-76717 stainless steel double robe hook. Located on the wall behind the door of single use restrooms at 48" AFF. Also see Shower Accessories above.

2.12 FABRICATION

A. General: Only an unobtrusive stamped logo of manufacturer, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by means of either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.

B. General: No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item by either a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.

C. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless-steel piano hinge. Provide concealed anchorage wherever possible.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install toilet accessory units in accordance with manufacturers' instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored per ADA or TAS requirements and heights. Provide wood blocking as required in the wall for anchoring.

3.02 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces after removing temporary labels and protective coatings.

END OF SECTION

SECTION 10 73 00
ALUMINUM CANOPY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Canopy.

B. Related Requirements: Division 1 – General Requirements

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American Welding Society (AWS):
   i. Standard D1.2 – Structural Welding Code – Aluminum

C. American Architectural Manufacturers Association (AAMA):
   i. Aluminum finishes AAMA 2603 Powder Coat
   ii. Aluminum finishes AAMA 2605 Kynar
   iii. Aluminum finishes AAMA 611 Anodize

1.03 SUBMITTALS

A. Shop Drawings: Indicate size, material and finish. Include plan elevation pages to clearly outline canopy locations. Include installation procedures, details of joints, attachments and clearances. Provide lead time for product and note possible conflicts with standard line.

B. Color charts showing manufacturer's full range of colors from standard line.

1.04 Warranty

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal canopies that fail in materials or workmanship within specified warranty period.

   i. Warranty Period: One year from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Specifications are based on Architectural Fabrication, Inc. - Architectural Fabrication, Inc. - Manufacturer and Installer is located at 2100 E. Richmond Avenue, Fort Worth, TX 76104. 800.962.8027. www.arch-fab.com

B. Substitutions are not acceptable.

2.02 MATERIALS

Helios Canopy

A. Framing: Gutter fascia, tube, angles: 6063-T5 alloy extruded aluminum

B. Decking: Interlocking panels, extruded aluminum or sheet metal

C. Hanger Rods: Zinc plated steel and powder coat (Prime and paint are not acceptable)

D. Connections: Wall plates and canopy mounting brackets are to be aluminum.

E. Hardware and Fasteners: Nuts, bolts, washers, clevis pins, screws, anchors and pipe spacers to be zinc plated or galvanized steel required to suit application and per pre-engineered canopy load requirements.

F. Flashing: Shall be minimum 0.040-inch aluminum, fabricated to prevent leakage and sealed with Novaflex metal roof sealant in clear or color match. Other equivalent sealant is acceptable.

G. Finish: Powder coat finish per ASTM D 3451, complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking and minimum dry film thickness. Color to be selected from standard color line.

PART 3 – EXECUTION

3.01 FABRICATION

A. Fabricate and preassemble canopies in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

3.02 INSTALLATION

A. Install canopies per manufacturer's written instructions and as indicated on drawings.

B. Locate and place canopies level, plumb and at indicated alignment with adjacent work.

C. Use concealed anchors where possible.

D. Repair damaged finishes so no evidence remains of corrective work. Return items to the factory that cannot be refinished in the field. Make required alterations and refinish entire unit or provide new units.

E. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a coating of bituminous paint or elastomeric coating on surfaces that will be in contact with concrete, masonry or dissimilar metals.

END OF SECTION

SECTION 11 31 00

RESIDENTIAL APPLIANCES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES

A. Residential Range, Exhaust Hood

B. Undercounter Dishwasher

C. Undercounter Ice Maker

1.03 RELATED WORK

A. Division 7 – Caulking and Sealant.

B. Division 8 – Painting

C. Division 22 – Plumbing

D. Division 26 – Electrical

1.04 SUBMITTALS

A. Product Data: Submit one package of all appliance in this section at the same time. Include rated capacities, operating Characteristics, dimensions, furnished accessories, and finishes for each appliance.

B. Product Schedule: For appliances. Use same designations indicated on Drawings.

C. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Installer Qualifications: An employer of workers trained and approved by each manufacturer for installation and maintenance of units required for this Project.

C. Source Limitations: Obtain each type of residential appliance from single manufacturer.

D. Regulatory Requirements: Comply with the following:
   1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.06 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period except as qualified below:
   1. Warranty Period: Two years from date of Substantial Completion.

B. Warranty Period for Other Components: Two years from date of Substantial Completion.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver, store, and protect products to site under provisions of General Conditions.

PART 2 – PRODUCTS

2.01 COOK TOP/OVEN and EXHAUST HOOD

A. Electric Cooktop/Oven:
   1. Acceptable Product: Whirlpool Model #WEE750H0H Smart Slide-in Electric Range
   2. Width: 30 inches
   3. Electric Burners: five
      A. Coking Zones: Individual.
   5. Capacity: 6.4 cu. Ft.
   6. Material: Black ceramic surface material
   7. Include all utility connections as required. Coordinate clearance requirements before ordering.

B. Exhaust Hood – 30" Monsoon I 600 CFM Ducted Insert Range Hood in Stainless Steel with Integral Blower & Nightlight. Fan and light controls shall be factory mounted on the hood with remote control unit (or hardwired to accessible location in accordance with all accessibility requirements). Include all utility connections as required. Coordinate clearance requirements before ordering. Coordinate all vent piping requirements with Mechanical documents and provide all necessary parts and accessories for a complete and operational unit, whether or not specifically listed.

2.02 DISHWASHER

A. Basis-of-Design Product: Bosch 800 Series 24” SGX78B55UC. Furnish and install an ADA compliant complete and operational undercounter dishwasher with rough opening approximately 24 x 32 1/2in. Include all utility connections and drain as required. Coordinate clearance requirements before ordering dishwasher. Coordinate and provide power requirements and plug configuration and provide all necessary parts and

accessories for a complete and operational unit, whether or not specifically listed.

2.03 UNDERCOUNTER ICE MAKER

A. Under-Counter Ice Maker – Laboratory: Basis of design: Kitchen Aide KUID508HPS 18" undercounter ice maker. Include all utility connections including power, water and drain as required whether or not specifically indicated. Coordinate clearance requirements before ordering and prior to fabrication of cabinets.

B. Under-Counter Ice Maker – Breakroom: Basis of design: Perlick H80CIMS-AD 15" ADA-Compliant cubelet ice maker. Include all utility connections including power, water and drain as required whether or not specifically indicated. Coordinate clearance requirements before ordering and prior to fabrication of cabinets.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

A. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

B. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods and microwave ovens with vented exhaust fans will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

E. Utilities: See Divisions 22 and 26 for plumbing and electrical requirements.

END OF SECTION

SECTION 11 53 00

LABORATORY EQUIPMENT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES

A. Laboratory Furnace

B. Laboratory Oven

C. Fume Hood

D. Drying Rack

E. Laboratory Refrigerator

F. Laboratory Vacuum System

G. Microscope

H. Microscope lenses

I. Balance

1.03 RELATED WORK

A. Division 7 – Caulking and Sealant.

B. Division 8 – Painting

C. Division 22 – Plumbing

D. Division 26 – Electrical

1.04 SUBMITTALS

A. Product Data: Submit one package of all equipment in this section at the same time. Include rated capacities, operating Characteristics, dimensions, furnished accessories, and finishes for each appliance. Substitutions for products specified are only allowed under Section 01 60 00

B. Product Schedule: For Equipment. Use same designations indicated on Drawings.

C. Operation and Maintenance Data: For each equipment item include operation and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within 250 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Installer Qualifications: An employer of workers trained and approved by each manufacturer for installation and maintenance of units required for this Project.

C. Regulatory Requirements: Comply with the following:
1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.06 WARRANTY

A. Special Warranties: Manufacturer's standard form Warranty including minimum 2 years parts and labor, plus 3 year compressor warranty from date of Substantial Completion.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver, store, and protect products to site under provisions of General Conditions.

PART 2 – PRODUCTS

2.01 LABORATORY FURNACE

A. Basis of Design – Thermo Scientific Thermolyne small benchtop muffle furnace, catalog no. FB1315M. Include all utility connections as required. Coordinate all electrical requirements and plug configurations as needed for a complete and operational unit, whether or not specifically listed. Approximate exterior dimension is 13x9x14

2.02 LABORATORY OVEN

A. Basis-of-Design Product: Quincy Lab Oven Model 40AFE, 81L. Coordinate all electrical requirements and plug configurations (Nema 5-15 US) as needed for a complete and operational unit, whether or not specifically listed. Approximate exterior dimension is 20x35x16.3

2.03 FUME HOOD and BASE CABINET

A. Basis-of-Design Product: Basis of Design: 48” Labconco Protector Premier Chemical Fume Hood (100400040) and 48” base cabinet unit (9900000). Include filler panels on base cabinets, resin work surface, outlets in the back, lights, switch and all utility connections, wiring, and accessories for lighting and ventilating, and sash for closing the unit. Include

Integral Blower unit (refer to Mechanical for ducting through the roof). Coordinate clearance requirements before ordering equipment. Coordinate and provide power requirements, plug configuration, and ventilation requirements and provide all necessary parts and accessories for a complete and operational unit, whether or not specifically listed.

2.04 DRYING RACK

A Basis-of-Design Product: Fisher Brand HIPS S29129. Provide in laboratory as indicated on drawings. Installed per manufactures recommendations.

2.05 LABORATOR REFRIGERATOR

A. Basis-of-Design Product: Thermo Scientific TSG Series General Purpose Laboratory Refrigerator model no. TSG45RSLA. It shall have double glass doors with lock and keys. Coordinate utility requirements and plug configuration before ordering. Both doors shall have sensor notification for when the door is left ajar as well as high and low temperature alarms.

2.06 LABORATORY VACUUM SYSTEM

A. Provide a complete and operational 6 place manifold system. Field verify exact location with Owner. Basis-of-Design: Welch Vacuum and VWR or Fisher Scientific. Two (2) each of the Welch 2037B-01vacuum pumps. Include ¼: ID Vacuum Tubing (part number 331030-5; 5 ft of ¼"ID Vacuum tubing and 305320 Hose clamps for the ¼" ID Vacuum hose for a leak-proof connection for each unit. Additionally, provide a 4 Liter Carboy and the cap for a liquid trap. Coordinate and provide all utility requirements and plug configuration before ordering. System shall be bid, installed and operating as one complete and functional system whether or not specific parts are listed.

2.07 MICROSCOPE

A. Nikon Eclipse Ci-L Plus Upright Microscope model no. 2CE-MQWK-2. Provide in laboratory as indicated on drawings. Substitutions under provisions of General Conditions and shall be approved by Architect prior to Pre bid meeting.

2.08 MICROSCOPE LENSES

A. Nikon CFI Achromat series lenses. Provide in laboratory as indicated on drawings. Integral with microscope. Substitutions under provisions of General Conditions and shall be approved by Architect prior to Pre bid meeting.
1. DL 10X (Phase 1)
2. LWD DL 20X (Phase 1)
3. DL 40X (Phase 2)
4. DL 100X Oil (Phase 3)

2.09 BALANCE

A. Mettler Toledo Model No. ME104TE. Provide in laboratory as indicated on drawings. Substitutions under provisions of General Conditions and shall be approved by Architect prior to Pre bid meeting.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

A. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

B. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust fans will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: See Divisions 22 and 26 for plumbing and electrical requirements.

END OF SECTION

SECTION 12 24 00
ROLLER SHADES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 SCOPE

A. Furnish and install Manual Roller Shading System at each exterior window except in Dog Adoption and Dog Intake.

.

1.03 QUALITY ASSURANCE

A. Installer's qualifications:

1. The Installer shall be a firm qualified to install the product specified, as demonstrated by prior experience.

1.04 SUBMITTALS

A. One complete shade assembly, including components listed in Part 2.

B. Submit working drawings of assembly and mounting details shall be submitted. Written certification attesting to the fabric's fire retardant properties shall be submitted.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:

1. Materials shall be stored in a clean area free of corrosive fumes and dust, and away from construction activities.
2. Materials shall be stacked horizontally using plastic or wood shims such that drainage and ventilation are provided for, and such that water cannot accumulate in, about, or upon the containers.
3. Stacks shall be covered with tarpaulins or plastic to prevent contaminants from contacting surfaces, while also allowing for ventilation.

1.06 PROJECT / SITE CONDITIONS

A. Roof must be tight, windows and frames installed and glazed, and interior doors hung, before installation begins.

B. Wet work including concrete, masonry, plaster, stucco, terrazzo, sheet rock, spackling, and taping (including sanding) shall be complete and dry.

C. Ceilings, window pockets, and electrical and mechanical work above the product shall be complete.

1.07 WARRANTY

A. Product warranted against manufacturing defects in materials and workmanship for 10 years.

B. Fabric warranted for intended use – interior for 10 years.

PART 2 – PRODUCTS

2.01 MANUFACTURER AND PRODUCT DESCRIPTION

A. Acceptable Product: SKYCO™ Shade systems (Tech™ Shade), Timberblind Metro Shade in McKinney, TX. , MechoShade, Hunter Douglas, or Solarfective.

B. Materials:

1. 2 ½" O.D. aluminum extrusion tube (w/R24). Fabric shall be affixed to the roller with a vinyl interconnect strip welded to the fabric and inserted into a groove in the tube.
2. Clutch shall be:
    a. R24 clutch is a wrap-spring design. The material is an engineered high-strength, glass-reinforced Valox polyester or Type 6 nylon by GE Plastics. It shall incorporate 5 high-carbon steel springs to transmit motion from driving to driven members of clutch mechanism. Clutch shall operate bi-directionally using an endless beaded chain.
3. Idler shall be of high-strength glass-reinforced Valox polyester, consisting of an outside sleeve and center shaft. Sleeve shall provide bearing surface for roller tube and shall rotate freely on center shaft, providing smooth, quiet, and long-wearing operation. A spring lift assist is used on shades over 10 lbs. on R16 and 12 lbs. on R24 mechanisms.
4. Control loop shall be an endless qualified #10 stainless steel ball chain. Control loop shall be of sufficient length to operate from a convenient position and shall meet accessibility reach range requirements.
5. Installation brackets for each end of the roller tube shall be .125" thick steel. Brackets shall accommodate overhead, side, or face mounting with the clutch assembly on either end of roller.
6. Shade fabric shall be:
    a. Fabric to be selected from line of standard fabrics consisting of a PVC coated fiberglass, polyester, or a combination polyester/fiberglass.
    b. Fabric shall be cut square with sonic blade cutting machines.
    c. Fabric shall hang straight and flat without buckling or distortion. Fabric to be adequately heat-set at cross links of fabric to prevent unraveling.
    d. Fabric shall have a 3% openness factor except in Meeting / Training room where it should be a double shade with an option for a black out shade.

e. Fabric shall be flame retardant and fade resistant to commercially accepted standards.
f. Single shades shall be seamless vertically in widths from 72" – 120" depending on selected fabric. For wider applications, fabric shall be rotated 90^0 and horizontally seamed.

7. Hembar bottom weight shall be custom shape aluminum extrusion profile enclosed in a permanently heat-welded fabric hem pocket.
8. Fascia panels shall be of .062" extruded aluminum with a high-quality enamel finish. Panel shall snap securely onto mounting brackets concealing roller tube and mounting hardware. Fascia mounting brackets for each end of the roller tube and support fascia panel shall be at least .060" thick steel with a high-quality enamel finish. Brackets shall accommodate overhead or face mounting with clutch assembly on either side of roller. Outside mounting brackets are finished with smooth flat plates. Color of fascia and brackets shall be selected from manufacturer's standard color options.

PART 3 – EXECUTION

3.01 INSPECTION

A. Window treatment subcontractor shall be responsible for inspecting site, field measurements, and approving mounting surfaces and installation conditions.

B. Subcontractor shall verify that site is free of conditions that interfere with shade installation and operation and shall begin installation only when any unsatisfactory conditions are rectified.

3.02 INSTALLATION

A. Installation shall comply with manufacturer's specifications, standards, and procedures.

B. Installer shall use support brackets as per manufacturer's installation instructions however the brackets should not be attached directly to the frames.

C. Shade shall be installed with adequate clearance, and to permit unencumbered operation of shade and hardware.

D. Installer shall demonstrate shade to be in uniform and smooth working order.

E. Manufacture shall provide hooks on short chains for high windows and a pole for each room to allow operation of each high window.

3.03 CLEANING

A. Clean finished installation of dirt and finger marks.

END OF SECTION

SECTION 12 35 00
LABORATORY CASEWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Steel Casework – Painted and Stainless Steel
2. Work Surfaces
3. Table Frames

1.02 CASEWORK DESIGN REQUIREMENTS

A. Flush Inset construction: Surfaces of doors, drawers and panel faces shall align with cabinet fronts without overlap of case ends, top or bottom rails. Horizontal and vertical case shell members (panels, tops rails and bottoms) shall meet in the same plane without overlap.

B. Interior of case units: Easily cleanable, flush interior. Base cabinets, 30" and wider, with double swinging doors shall provide full access to complete interior without center vertical post.

C. Self-supporting units: Completely welded shell assembly without applied panels at ends, backs or bottoms, so that cases can be used interchangeably or as a single, stand-alone unit.

D. Case openings: Rabbeted-like joints all four sides of case opening for hinged doors and two sides for sliding doors in order to provide dust resistant case.

E. Drawers: Sized on a modular basis for interchangeability to meet varying storage needs, and designed to be easily removable in the field without use of special tools.

F. Doors: Solid or glazed, double wall telescoping box steel construction, interior sound deadening, removable hinges standard.

1.03 CASEWORK PERFORMANCE REQUIREMENTS

A. Structural Performance Requirements: Casework components have been tested in conformance with SEFA 8 M-2007 Recommended Practice and shall withstand the following maximum static load capacity, without damage to the component or to the casework operation, when properly leveled, supported and the load evenly distributed:

1. Steel base units: 500 lbs. per lineal ft.
2. Suspended units: 300 lbs.
3. Drawers in a cabinet: 150 lbs. per drawer
4. Utility tables (4 legged): 300 lbs.
5. Hanging wall cases: 300 lbs.
6. Shelves (base, wall, tall units) 40 lbs./sq.ft., up to 200 lbs.

B. Metal Finish Performance Requirements: Coatings on Casework components have been tested in conformance with the full requirements of SEFA 8 M-2010 Recommended Practice. See Section 2.07 for test procedures, acceptance levels and results for each criteria listed below from SEFA 8 M-2010 Section 8:

1. Chemical Spot Test – Section 8.1
2. Hot Water Test – Section 8.2
3. Finish Impact Test – Section 8.3
4. Paint Adhesion on Steel – Section 8.4
5. Paint Hardness on Steel – Section 8.5

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Casework wholly manufactured and assembled in the USA by: Jamestown Metal Products Division of Institutional Casework, Inc., 178 Blackstone Avenue, Jamestown, New York, 14701. Campbell Rhea, and Kewaunee, in compliance with these specs, is also an acceptable manufacture. Local contact - johnlmays@indecoeagle.com

B. Substitutions may be approved by Architect when submitted prior to pre-bid meeting.

2.02 MATERIALS

A. Typical sheet steel used in the construction of cases and related products:

1. Mild carbon, cold rolled and leveled unfinished steel, ASTM A 1008
2. Stainless steel, #4 finish one side, ASTM A 666
3. Mild carbon, cold rolled and hot dipped galvanized steel

B. Unless otherwise noted, the typical gauge of steel used in the construction of cases and related products shall be 18 GA. Exceptions listed below:

1. 11 GA – table leg stretcher and leg rail support brackets
2. 12 GA – bottom corner gussets
3. 14 GA – hinge reinforcements, suspension channels
4. 16 GA –table cross rails, apron rails and end rails
5. 20 GA – inner door panels, filler stiles, fixed back panels, drawer bodies
6. 22 GA – removable back panels

C. Glass for glazed swinging, sliding and frameless doors as follows:

1. ¼" Clear Float Glass – standard for swinging & sliding doors
2. ¼" Tempered Glass per ASTM C 1048 – standard for frameless doors

2.03 CASEWORK CONSTRUCTION

A. Base Cabinets:

1. Provide depths: 12”, 24”, 30” and 36”; and heights as indicated on drawings.
2. One-piece formed end panels and back with internal reinforcing front posts
3. Front post fully closed with full height reinforcing upright.
4. Shelf adjustment holes in front and rear posts shall be perfectly aligned for level setting, adjustable to 1/2" increments.
5. Base cabinet drawer units provided with backs; cupboard units provided with removable backs for service access.
6. Tall cabinet units provided with full formed backs, recessed 1/8” for mounting purposes.
7. One-piece bottom with formed front edge spot welded to front rail. Rabbeted as required for swinging doors and drawers; flush for sliding doors.
8. Top rail interlocks with and welded to end panels, flush with front of unit; reinforced for suspended units.
9. Formed steel base provides minimum 3.750” high by 3.000” deep toe-kick space; reinforcing corner gussets accommodate standard ½-13 UNC x 2.500” zinc plated leveling bolt, accessible through bottom panel on Base and Tall Cabinets where applied.

B. Wall Cabinets 12” deep:

1. Heights as indicated on drawings.
2. One piece formed end panels and back with internal reinforcing front posts.
3. Front post fully closed with full height reinforcing upright.
4. Shelf adjustment holes in front and rear posts shall be perfectly aligned for level setting, adjustable to ½" increments.
5. One-piece formed back, recessed ¾” for mounting purposes.
6. One-piece top with front edge formed into front rail.
7. One-piece bottom with front edge formed into front rail.
8. Note: All exposed seams on joints will be welded, ground and polished to an equivalent mill finish.

C. Drawers:

1. Drawer fronts: 5/8" thick, double wall construction, assembled with sound deadened material, top front corners fitted smooth.
2. Drawer bodies:
   a. 22 GA stainless steel, 1-pc construction, bottom and sides coved and top edges formed. No sharp edges.
3. No tools required for removal.
4. Drawer suspension:
   a. Removable full extension Accuride (or equivalent) slide; tested and rated 150 lb. static and dynamic.
5. Provide drawer with rubber bumpers. Friction centering devices are not acceptable.
6. Provide security panels for drawers with keyed different locks (as required).

D. Doors:

1. Solid panel doors: 5/8” thick, double wall, telescoping box steel construction with interior sound deadening, outer corners fitted smooth. Hinges with screws to internal 14 gauge reinforcement in case and door. Hinges shall be removable; welding of hinges not acceptable. Doors shall close against rubber bumpers.
2. Frame glazed doors: Outer head to be one-piece construction with beaded edges. Inner head shall be one-piece construction also, telescoping, and secured with screws to outer head; removable for installation or replacement of glass. Provide vinyl glazing retainer to receive glass. In all other respects, framed glazed door construction and quality shall match solid panel doors.
3. Sliding doors - solid or framed glazed: Designed for tilt-out removal. Doors shall ride on nylon tired sleeve bearing rollers in aluminum extended bottom hung track and shall close against rubber bumpers.
4. Unframed sliding glass doors: Glass with edges ground set in extruded aluminum shoe with integral pull (top and bottom extruded aluminum track). Provide rubber bumpers at fully opened and closed door position.

E. Shelves:

1. Casework shelves: Die formed steel, front and back edges formed down and back 1"; ends formed down ¾”.
2. Reinforced shelves: Shelves over 36” long and 16” deep include hat channel reinforcement, full length of the shelf.
3. Pull out shelves: Same suspension as specified for drawers.

F. Base molding: 4" high typical, to be furnished and installed by others.

G. Hardware:

1. Wire pulls: Modern design, offering a comfortable hand grip, and be securely fastened to doors and drawers. Two pulls shall be required on all drawers 30” and longer.
2. Flush pulls:
   a. Modern design, zinc die cast metal providing a semi-recessed appearance and comfortable finger grip.
   b. Modern design, ABS plastic, Chameleon, providing a semi-recessed appearance and comfortable finger grip.
   c. Modern design, ABS plastic, Black, providing a semi-recessed appearance and comfortable finger grip.
   Finger holes or slots machined into doors are not acceptable.
3. Hinges: Brushed stainless steel type, 5-knuckle, frictionless, not less than 2" long with fast pin and rounded ends. Hinges are attached to both door and case with three (3) screws through each leaf. Doors over 36" in height shall be hung using 3 hinges.
4. Removable Core Locks:
   a. 5-pin tumbler
   Applied to doors and drawers where specifically requested in the specifications or on the equipment list, and shall be keyed and master-keyed as directed.

5. Door Catches: Adjustable nylon roller type, with strike.
6. Leveling Devices: Zinc plated ½"-13 UNC threaded bolt type.
7. Shelf Clips: Die formed steel, zinc plated, designed to provide shelf support and adjustment in ½" increments
8. Label Holders: Applied (in the field) to doors and drawers where specifically requested in the specifications or on the equipment list, shall be self adhesive type aluminum with satin finish and designed for 2-1/2" x 1-1/8" cards, unless otherwise specified.
9. Up-and-Down Bolts: Optional on hinged full height storage cases, they shall have a right hand door provided with an active knob and up-and-down bolt assembly. Left hand door shall be provided with a dummy knob. Up-and-down bolts shall be concealed in the stiles of glazed doors and between pans of solid panel doors.

2.04 WORK SURFACES

A. Epoxy Resin: Epoxy resin manufactured from a mixture of materials like epichlorohydrin (ECH) and bisphenol-A (BPA) and fillers. Fillers like silica, metal, and glass may be added for strength.

2.05 TABLE FRAMES

A. Table frames: 4-1/2" high "C" channel front and back aprons, end rails and cross rails.

B. Table drawers: Provide front and back rails; drawer unit, hardware and suspension same as specified for base unit drawers.

C. Legs: 2" x 2" steel tube legs with welded 11 GA leg bracket. Attach legs with two bolts to front and back aprons and weld to end rails. Each leg shall have a leveling screw.

D. Leg Shoes: Provided on all table legs to conceal leveling device, unless otherwise specified. Shoes shall be pliable, black vinyl material.

2.06 SPECIAL PURPOSE CABINETS (Not under this spec section for this project) refer to Greenville 11070

2.07 SINKS

A. Stainless Steel Sinks: Shall be fabricated from Type 304 stainless steel per ASTM A 666, except where Type 316 stainless steel is specified. All expose surfaces shall be finished in No. 4 finish. All sink surfaces (sides and bottoms) shall be full 16 gauge metal thickness unless heavier gauges are specified. Deep drawn sinks are not acceptable. All sink joints shall be continuously welded by heliarc welding process. Inside radii shall be 1". Bottoms shall be pitched to the drain indent. Sink bowl shall be welded to the top as to form an integral part thereof where sinks are built into stainless steel tops or working surfaces. Top edges of free standing sinks shall be formed into a channel formation with all joints welded and ground smooth and polished. No soldering shall be permitted in connection with sink construction. Stainless steel sinks shall be furnished with crumb cup strainers unless otherwise specified.

B. Sink Supports: Sink supports shall be the hanger type, suspended from top front and top rear horizontal rails of sink cabinet by four (4) 1/4" dia. rods, threaded at bottom end and offset at top to hang from two full length reinforcements welded to the front and rear top rails. Two 3/4" x 1-1/2" gauge channels shall be hung on the threaded rods to provide an adjustable sink cradle for supporting sinks. When sink capacity exceeds 3,750 cu. in., the sink supports shall be suspended from full length reinforcements welded to the two end rails. Two 1" x 2" x 10 gauge full length channels shall be hung from the four 1/4 " dia. rods to provide an alternate sink cradle

2.08 METAL FINISH

A. Preparation: Metal shall be treated with a heated alkaline based acid solution, rinsed with water, and a coat of epoxy-link applied; immediately dried in heated ovens, then gradually cool prior to application of finish.

B. Application: Electrostatically apply epoxy powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thicknesses:

1. Exterior and interior surfaces exposed to view: 1.8 – 3 mils.
2. Backs of cabinets and other surfaces not exposed to view: 1.8 mils minimum.

C. Chemical Spot Test :

1. Test procedure: Place test panel on a flat surface, clean with soap and water and blot dry. Condition the test panel for 48 hours at 73°F ± 3°F and 50% ± 5% relative humidity. Panel will be subjected to chemical reagents according to SEFA 8 M-2010 Recommended Practice using one of the following two test methods:
   a. Method A – Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a 1-oz. bottle and inverting the bottle on the surface of the panel.
   b. Method B – Test non-volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24 mm watch glass, convex side down.
   c. For both test methods, leave the reagents on the panel for a period of one hour. Wash off the panel with water, clean with detergent and naptha, and rinse with deionized water. Dry with a towel and evaluate after 24 hours at 73°F ± 3°F and 50% ± 5% relative humidity using the following rating system.
2. Evaluation ratings:
   a. Level 0 – No detectable change.
   b. Level 1 – Slight change in color or gloss.
   c. Level 2 – Slight surface etching or severe staining.
   d. Level 3 – Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.
3. Acceptance level: No more than four (4) level 3 conditions
4. Test results: Two (2) level 3 conditions exist. See data below.

REAGENT	METHOD	RATING
Acetate, Amyl	A	0

Acetate, Ethyl	A	0
Acetic Acid, 98%	B	1
Acetone	A	0
Acid Dichromate, 5%	B	0
Alcohol, Butyl	A	0
Alcohol, Ethyl	A	0
Alcohol, Methyl	A	0
Ammonium Hydroxide, 28%	B	0
Benzene	A	0
Carbon Tetrachloride	A	0
Chloroform	A	0
Chromic Acid, 60%	B	2
Cresol	A	1
Dichlor Acetic Acid	A	2
Dimethylformanide	A	1
Dioxane	A	1
Ethyl Ether	A	0
Formaldehyde, 37%	A	0
Formic Acid, 90%	B	3
Furfural	A	2
Gasoline	A	0
Hydrochloric Acid, 37%	B	0
Hydrofluoric Acid, 48%	B	1
Hydrogen Peroxide, 28%	B	0
Iodine, Tincture of	B	2
Methyl Ethyl Ketone	A	1
Methylene Chloride	A	1
Mono Chlorobenzene	A	0
Naphthalene	A	0
Nitric Acid, 20%	B	1
Nitric Acid, 30%	B	1
Nitric Acid, 70%	B	3
Phenol, 90%	A	0
Phosphoric Acid, 85%	B	0
Silver Nitrate, Saturated	B	1
Sodium Hydroxide, 10%	B	0
Sodium Hydroxide, 20%	B	0
Sodium Hydroxide, 40%	B	0
Sodium Hydroxide, Flake	B	0
Sodium Sulfide, Saturated	B	0
Sulfuric Acid, 25%	B	0
Sulfuric Acid, 77%	B	0
Sulfuric Acid, 96%	B	0
Sulfuric Acid (77%) & Nitric Acid (70%), (equal parts)	B	2
Toluene	A	0
Trichloroethylene	A	0
Xylene	A	0
Zinc Chloride, Saturated	B	0

D. Hot Water Test

1. Test procedure: Hot water (100°C±3%) shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces [177.44cc] per minute) on a finished surface, which shall be set at an angle of 45-degrees, for a period of five minutes.
2. Acceptance level: After cooling and wiping dry, the finish shall show no visible effects from the hot water.
3. Test results: The finish shows no visible effect due to the hot water.

E. Finish Impact Test:

1. Test procedure: Position the 18 GA CRS test panel with nominal paint thickness of 3 mils on a smooth concrete floor. A one-pound ball (approximately 2" in diameter) shall be dropped from a distance of 12" onto a flat horizontal surface.
2. Acceptance level: There shall be no visual evidence to the naked eye of cracks or checks in the finish due to impact.
3. Test results: There is no visual evidence of any cracks or checks due to impact.

F. Paint Adhesion on Steel:

1. Test procedure: This test is based on ASTM D3359-02 "Standard Test Methods for Measuring Adhesion by Tape Test 1 – Test Method B". Two sets of six parallel lines 2mm apart shall be cut with a razor blade to intersect at right angles thus forming a grid of 25 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. Brush the grid area lightly with a soft brush, and then place a piece of tape over the grid. Rub the tape firmly with the eraser of a pencil to ensure good contact. Remove the tape by rapidly pulling it back upon itself as close to an angle of 180° as possible.
2. Acceptance level: A 4B rating or better (ninety-five percent or more of the grid area shall show finish intact.
3. Test results: 100% of the squares remained intact after the test.

G. Paint Hardness on Steel:

1. Test procedure: This test is based on ASTM D3363-01 "Standard Test Method for Film Hardness by Pencil Test". Clip a corner of the sample at 45° exposing a raw metal edge. Place the sample on a raw metal base plate so that the exposed metal edge of the sample makes contact with the turned up side of the base plate. Remove approximately 6mm of wood from a 4H pencil, being careful to leave an undisturbed smooth cylinder of lead. Holding the pencil at an angle of 90° to an abrasive paper, rub the lead against the paper maintaining an exact angle of 90° section until a flat smooth and circular cross section is obtained. On the other end of the pencil remove approximately 13mm of wood from on half of the pencil. Install the pencil into a Sheen model 720N Pencil Scratch Hardness Tester. Follow the manufacturer's instructions for conducting the test.
2. Acceptance level: The paint finish shall withstand the abrasion of a 4H pencil without penetrating through to the substrate and completing a continuous circuit.
3. Test results: The 4H pencil did not penetrate the substrate during the test.

Note: manufacturer shall provide independent certified test report on chemical resistance of finish if requested.

2.09 QUALITY ASSURANCE

A. Single source responsibility: Casework, work surfaces, laboratory fume hoods, equipment and accessories shall be manufactured or furnished by a single laboratory furniture company.

B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled workmen to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:

1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.
2. Ten installations of equal or larger size and requirements.

C. Installer's qualifications: Factory trained and/or certified by the manufacturer.

D. Cabinet identification: Cabinets are identified on drawings by manufacturer's catalog numbers. Unless otherwise modified on drawings or in specifications, catalog description constitutes specific requirements for each type of cabinet.

PART 3 – EXECUTION

3.01 INSTALLATION - REFER TO INSTRUCTION AND INSTALLATION MANUAL

A. Casework installation:

1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as necessary using concealed shims.
2. Bolt continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1/16" tolerance.
3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.
4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8" between top units.
5. Remove and discard shipping clip and associated screws from top of shelf, (thin galvanized angle) install 4 shelf clips into integral standard and set shelf. Check for level and adjust clips as required.

B. Work surface installation:

1. Where required due to field conditions, scribe to abutting surfaces.
2. Only factory prepared field joints, located per approved shop drawings, shall be permitted. Secure joints in field, where practicable, in the same manner as in factory, with dowels, splines, adhesive or fasteners recommended by manufacturer.
3. Secure work surfaces to casework and equipment components with material and

procedures recommended by the manufacturer.

C. Sink installation: Sinks which were not factory installed shall be set in chemical resistant sealing compound and secured and supported per manufacturer's recommendations.

D. Accessory installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.

3.02 ADJUSTING

A. Repair or remove and replace defective work, as directed by Architect or Owner upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.03 CLEANING

A. Clean shop finished casework, touch up as required.
B. Clean counter tops with diluted dishwashing liquid and water leaving tops free of all grease and streaks. Use no wax or oils.

3.04 PROTECTION OF FINISHED WORK

A. Take protective measures to prevent exposure of casework and equipment from exposure to other construction activity.
B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

3.05 DELIVERY, STORAGE AND HANDLING

A. Schedule delivery of casework and equipment so that spaces are sufficiently complete that material can be installed immediately following delivery.
B. Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.
C. Protect all work surfaces throughout construction period with 1/4" corrugated cardboard completely covering the top and securely taped to edges. Mark cardboard in large lettering "NO STANDING".

3.06 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:

1. Windows and doors are installed and the building is secure and weather tight.

END OF SECTION

SECTION 13 34 23A
Fiberglass Reinforced Polymer (FRP) Building

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Shelter Name: Bleach & Bisulfite
   1. Size:
      a. Exterior Width: 6 ft
      b. Exterior Length: 12 ft
      c. Wall Height: 8 ft
   2. Roof Slope: Sufficient to allow rain drainage, 12^{o} – 17^{o} pitch.
   3. Roof Type: Roof shall be wind-resistant "hip" design sloping up from all four sides. Roof shall form a permanent weather-proof connection with a seamless exterior appearance that uses low-maintenance silicone caulk matching the shelter's exterior color.
   4. Roof deck is compliant with ASTM E 108/ULC S107 (class C) with <13' Flame Spread.
   5. Roof shall not overhang walls in order to maximize shelter's wind speed rating.

B. System: Design, furnish, and install complete package using manufacturer's standard components.

C. Structure Type: Fiberglass Reinforced Polymer (FRP) shelter on a formed and poured concrete pad as specified herein.

D. Submittals: Shelter vendor to provide one (1) digital version of shop drawings and manufacturer's data including the following:

   1. Dimensions, weight, materials, parts, devices, and all other information required to verify compliance with these Specifications.
   2. Manufacturer's Literature and Technical Data: Drawings and Specifications for proposed system.
   3. Drawings prepared specifically for this Project:
      a. Materials and Details: Show materials, details of components (including doors and other accessories), finishes, fastenings, methods of joining, sealants, anchor bolt details, structural members and bracing, and openings.
      b. Anchorage details of structure to foundation.

E. Operations and Maintenance (O&M) Manual including installation instructions, digital version only, to be provided after shelter ships.

1.02 QUALITY ASSURANCE

A. Qualifications:

1. Designers: Shop Drawings and all calculations shall be sealed and signed by a Professional Engineer (PE) licensed in the state where the shelter will reside.
2. Manufacturer:
    a. Longevity: At least 10 years' experience in work of the type required in this section.
    b. Capacity: Production throughput sufficient to provide work required for this Project without delay.
    c. Manufacturing facility for this shelter shall be located within the United States of America.
    d. Certified Test Results: The manufacturer shall have an entire fiberglass panel destructive tested by an accredited Testing Laboratory and Third Party Quality Control Agency and upon request shall furnish to the engineer the certified and stamped test results of the laboratory testing. The accredited Testing Laboratory must be accredited to ISO 17020 and 17025.
    e. Quality: The manufacturer shall maintain a quality assurance program that is reviewed and approved by a Third Party Quality Control Agency.
3. Erector/Installer:
    a. Not less than 2 years' experience in the offloading and installation of prefabricated structures.

B. Material Properties:
1. Fiberglass Laminate Properties:

a.	Tensile Strength (ASTM D 638)	16,000 (psi)
b.	Flexural Strength (ASTM D 790)	33,700 (psi)
c.	Flexural Modulus (ASTM D 790)	1,160,000 (psi)
d.	Tensile Modulus (ASTM D 638)	1,300,000 (psi)
e.	Barcol Hardness	45
f.	Izod Impact – Notched ((ft.-lbs)/in)	16.30
g.	Izod Impact – Unnotched ((ft.-lbs)/in)	21.79

2. Foam shall be rigid closed cell, polyisocyanurate with a density of 1.5 – 1.9 pounds per cubic foot.

a.	Flame Spread (ASTM E 84)	<75
b.	Smoke Development (ASTM E 84)	<450

1.03 DELIVERY, STORAGE, AND HANDLING

A. The fiberglass shelter and the accessory items shall be carefully transported, stored, handled and set in place in a manner that will prevent distortion, misalignment or other damage to the units.

B. During storage prior to installation and following installation, but prior to placing in service, the manufacturer's recommendations regarding handling shall be followed.

1.03 MANUFACTURERS WARRANTY

A. Manufacturer shall provide a twenty-five (25) year warranty on the shelter materials and workmanship, according to the following specifications:

1. The shelter will be free from manufacturing defects in workmanship and will not appreciably deteriorate under conditions of normal use and regular service and maintenance when installed properly, for a period of twenty-five (25) years from the original date of purchase.
2. Component parts will be purchased from reputable manufacturers and carry their own warranties.
3. Any shelter penetrations made by shelter manufacturer must be maintained by the Customer to ensure proper sealing. Suggested intervals is every (2) two years. All penetrations made by the Customer during shelter installation are the responsibility of the Customer and may void or limit the warranty if done improperly.

B. All warranties are Null and Void if the shelter and/or its components are modified or damaged as a result of unauthorized repair, misuse, negligence, accident, or act of God. This warranty does not cover vandalism, unreasonable use, damage caused by flying or falling objects, collision with animals or vehicles, or damages caused by environmental extremes or natural disasters, such as earthquakes, floods, hail or lightning.

PART 2 PRODUCTS

2.01 SHELTER MANUFACTURERS

A. Product from Shelter Works, St. Louis, MO as represented by Environmental Improvements, Inc. (713-461-1111), meeting these Specifications, may be used on this Project.

B. Equipment from alternate manufacturers shall not be acceptable unless pre-approved two weeks prior to bid date per Section 01 62 00 Substitutions and Product Options.

2.02 SYSTEM PERFORMANCE. Structural Loading:

A. Shelter: Own dead load.
B. Roof Load per ASCE 7-16. 20 psf live load
C. Wind Load per ASCE 7-16 (Risk Category III). 145 mph
D. Seismic Load: Per local building code

2.02 COMPONENTS

A. U-BOLTS. Through-wall lifting/tie-down eyes at the top of each corner to facilitate handling.

B. WALLS. Each wall shall be one single monolithic piece with faux brick textured appearance. Panelized construction not acceptable because connections could fail and leak over time.

C. CONNECTIONS. Wall panels shall overlap to form a permanent weather-proof connection with a seamless exterior appearance that uses low-maintenance silicone caulk matching the shelter's exterior color. Internal connections shall use stainless steel hardware spaced no more than 12" on center.

D. EXTERIOR. All exterior surfaces shall have 18-20 mils of superior performance marine grade gel coat, incorporating ultra-violet inhibitors. Exterior color shall be desert sand, polar white, meadow green, or storm gray.
E. INTERIOR. All interior surfaces shall be sprayed with 18-20 mils of Polycor 944 high quality isophthalic white gel coat finish offering the same characteristics as the exterior surfaces without ultra-violet inhibitors. Interior surface shall not contain any visible surface-mounted strut or other unsightly channel.

F. PARTITION. Nominally 6' wide wall to wall, 6' high from floor to 6' above floor.

G. BASE FLANGE. Shelter shall have an FRP mounting flange around the entire interior perimeter, ¼" thick x minimum 2" wide. Pockets which reduce the wall's full insulation value shall not be accepted. ConSeal Bitumen/Butyl sealant shall be provided for a weather-proof connection below the shelter's base. Flange shall be pre-drilled with 7/16" diameter holes 12" on center.

H. ACCESS
1. Pedestrian doors shall be made of fiberglass reinforced polymer (FRP) using exclusive FiberWrap technology to eliminate the possibility of edge delamination during the shelter's entire lifespan.

2. Pedestrian doors shall be hung with stainless steel ball bearing type hinges equipped with tamper-resistant, non-removable pins. Hinges shall be oriented with no fasteners exposed when door is closed.
3. Pedestrian doors shall be sealed with a weather-tight EPDM gasket along the entire perimeter of the door.
4. Pedestrian doors shall have a 2.5" deep aluminum rain drip molding located above.
5. All pedestrian doors must be able to be set in 'open' position with no hands. Doors must be able to be removed from 'open' position and closed with no hands. Doors must have hydraulic closer to prevent wind damage to door.
6. (2) 3'-0" wide x 6'-8" high single doors.
   a. Closure system is panic push bar, key-lockable.
   b. Threshold is ½" tall, low profile aluminum.
   c. Window on bleach side is nominal 15" x 15", insulated 2-pane, etch-resistant acrylic or Plexiglas, non-opening.
   d. Window on bisulfite side is nominal 15" x 15", tempered safety glass.

I. PENETRATIONS. (2) rectangular areas where the end-user can cut through wall or ceiling without exposing the core foam material thereby guaranteeing a weatherproof penetration for the life of the structure. Locations must not be visible from outside the shelter.

J. TERMINATION. Electrical terminations in load center located on bisulfite side, NEMA 1, 120/240V, single-phase, 100-amp main breaker and at least 10 breaker slots.

K. RECEPTACLES: (2) GFCI duplex each with weather-proof-when-not-in-use cover.

L. WIRING
1. Schedule 40 PVC conduit installed around the interior perimeter of the shelter, along the top of the wall. All conduit and fittings shall be UL Listed.
2. Conduit and wiring shall be installed in accordance with the most recent National Electric Code (NEC).
3. Minimum 12 gauge shall be used for wiring in conduit.
4. Wiring shall not be loaded above 60º C temperature rating.

M.ILLUMINATION
1. Vapor-tight, fluorescent light fixture(s) providing at least 100 lumen/sf.
2. Interior lights to be operated by (1) exterior mounted 2-way switch with weatherproof cover.

N. VENTILATION
1. (1) fan which shall be rated for at least 200 cubic feet per minute. Fan to be intake (blowing from outside in) with insect screen outside fan so screen is easy to

clean. Fan operation controlled by thermostat with switch override. Located low on bisulfite side.

2. (1) corrosion-resistant FRP gravity exhaust louver with insect screen and aperture size equal to or larger than the fan opening. Located low on wall of bleach side. Manual vents are not acceptable in order to avoid fan motor burnout which could occur if fan were energized when manual vents are closed.
3. Ventilation through-wall openings shall be protected from the elements with a weather-tight fiberglass hood the same color as the shelter itself.

O. MATERIALS

1. Walls, roof and doors shall be seamless, one-piece panels laminated with 1/8" thick sprayed fiberglass outside surface, core material, and 1/8” thick sprayed fiberglass inside surface. Walls and roof shall have continuous FiberBeam laminations (floor to ceiling and top-of-wall to ridge) every 12” to permanently bond inner FRP surface with outer FRP surface to provide structural integrity and prevent de-lamination of the fiberglass from the core material.
2. Walls and roof shall have minimum R-12 insulation with core consisting of minimum 1.5” thick foam.
3. Minimum 19/32” thick wood encapsulated within interior surface of all walls for mounting equipment.
4. Shelter interior on bleach side is a highly corrosive environment; all interior components on bleach side shall be corrosion resistant (e.g. PVC, PVC coated, FRP, stainless steel).

PART 3 EXECUTION

3.01 EXAMINATION.

A. Investigate site, including soils, to determine effect on proposed shelter.

3.02 PREPARATION.

B. Install concrete slab true and level to a maximum surface variance of 3/16” where the shelter interfaces with the slab.
C. The slab immediately surrounding the shelter perimeter shall be sloped away at a pitch of ½” per foot to promote proper drainage and eliminate the potential of standing water around the shelter.

3.03 ERECTION

A. At the time of installation, the slab shall be clean and dry.

B. Follow written offloading and installation instructions provided by shelter manufacturer.
C. Contractor shall provide any required Type 304 stainless steel expansion anchors.
D. Install and make final electrical connections to all equipment shipped loose with water-tight flexible conduit and fittings.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 14 24 00
MRL HYDRAULIC PASSENGER ELEVATORS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes: Machine room-less hydraulic passenger elevators as shown and specified. Elevator work includes:

1. Standard pre-engineered hydraulic passenger elevators.
2. Elevator car enclosures, hoistway entrances and signal equipment.
3. Operation and control systems.
4. Jack(s).
5. Accessibility provisions for physically disabled persons.
6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:

1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
4. Division 5 Metals:
    a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
    b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.

5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.

6. Division 16 Sections:

    a. Providing electrical service to elevators, including fused disconnect switches where permitted. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)

    b. Emergency power supply, transfer switch and auxiliary contacts.

    c. Heat and smoke sensing devices.

    d. Convenience outlets and illumination in control room (if applicable), hoistway and pit.

7. Division 22 Plumbing

    a. Sump pit and oil interceptor.

8. Division 23 Heating, Ventilation and Air Conditioning

    a. Heating and ventilating hoistways and/or control room.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the TK Elevator's proposal, since it is a part of the building construction.

    1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.

    2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.

    3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2'' at any point.

4. Elevator hoistways shall have barricades, as required.

5. Install bevel guards at 75° on all recesses, projections or setbacks over 2'' (4'' for A17.1 2000 areas) except for loading or unloading.

6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.

7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.

8. All wire and conduit should run remote from the hoistways.

9. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.

10. Install and furnish finished flooring in elevator cab.

11. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.

12. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.

13. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.

14. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.

15. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.

16. General Contractor shall fill and grout around entrances, as required.

17. All walls and sill supports must be plumb where openings occur.

18. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.

19. Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Typically this will be at the landing above the 1st floor. Final location must be coordinated with elevator contractor.

20. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.

21. For signal systems and power operated door: provide ground and branch wiring circuits.

22. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.

23. Controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.

24. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc..

1.02 SUBMITTALS

A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:

1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.

2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.

3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.

4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Powder Coat paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

E. Metal Finishes: Upon request, standard metal samples provided.

F. Operation and maintenance data. Include the following:
   1. Owner's manuals and wiring diagrams.

   2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.

   1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.

      a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.

   2. The manufacturer shall have a documented, on-going quality assurance program.

   3. ISO-9001:2000 Manufacturer Certified

   4. ISO-14001:2004 Environmental Management System Certified

   5. LEED Gold certified elevator manufacturing facility.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:

1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.

2. Building Code: National.

3. NFPA 70 National Electrical Code.

4. NFPA 80 Fire Doors and Windows.

5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)

6. Section 407 in ICC A117.1, when required by local authorities

7. CAN/CSA C22.1 Canadian Electrical Code

8. CAN/CSA B44 Safety Code for Elevators and Escalators.

9. California Department of Public Health Standard Method V1.1–2010, CA Section 01350

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.

2. Arrange for inspections and make required tests.

3. Deliver to the Owner upon completion and acceptance of elevator work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.07 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.

1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.

2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.

3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Design based around TK Elevator’s Endura Machine Room-Less hydraulic elevator. Substitution requests per section 01 60 00. Note if an alternate product is requested for substitution, the manufacture will be responsible for all changes necessary as a result of the request, including but not limited to dimensions, sizes, ratings, pits, clearances, etc.

2.02 MATERIALS, GENERAL

A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.

B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

C. Steel:
   1. Shapes and bars: Carbon.
   2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
   3. Finish: Factory-applied powder coat for structural and architectural parts. Color selection must be based on elevator manufacture's standard selections.

D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture's standard selections.

E. Flooring by others.

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.

D. Guides: Slide guides shall be mounted on top and bottom of the car.

E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast

iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 2-stage. Two jacks piped together, mounted one on each side of the car with each having two telescopic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section..

G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade readily biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details)

I. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform “flooded pit operation”, which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.

J. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

2.04 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:

1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather

2. An oil hydraulic pump.

3. An electric motor.

4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.

D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.

1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.

2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.

3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.

4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.

5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.

6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.

7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)

8. Oil Type: USDA certified biobased product, ultra low toxicity, readily biodegradable, energy efficient, high performing fluid made from canola oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Especially formulated for operating in environmentally sensitive areas. USDA certified biobased product, >90% bio-based content, per ASTM D6866

2.05 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.

   1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.

   2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.

   3. Typical door & frame finish: Stainless steel panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.

B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.

C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3 phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details

D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

E. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.

   1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.

2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.

3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:

1. Walls: Cab type TKAP, reinforced cold-rolled steel with two coats factory applied baked enamel finish, with applied vertical wood core panels covered on both sides with high pressure plastic laminate.

2. Reveals and frieze: a. Reveals and frieze: Powder Coated

3. Canopy: Cold-rolled steel with hinged exit.

4. Ceiling: Suspended type, LED lighting with translucent diffuser mounted in a metal frame. Framework shall be finished with a factory applied powder coat finish.

5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel

6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.

   a. Door Finish: Stainless steel panels: No. 4 brushed finish.

   b. Cab Sills: Extruded aluminum, mill finish.

7. Handrail: Provide 2' flat metal bar on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.

8. Ventilation: Manufacturer’s standard exhaust fan, mounted on the car top.

9. Protection pads and buttons: Not required

B. Car Top Inspection: Provide a car top inspection station with an “Auto-Inspection” switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.

2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.

3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.

4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.

5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.

6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.

7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.

8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel: Not Required

D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

E. Special Equipment: Not Applicable

2.09 CONTROL SYSTEMS

A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:

1. Access to main control board and CPU
2. Main controller diagnostics
3. Main controller fuses
4. Universal Interface Tool (UIT)
5. Remote valve adjustment
6. Electronic motor starter adjustment and diagnostics
7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
8. Operation of auxiliary pump/motor (secondary hydraulic power source)
9. Operation of electrical assisted manual lowering
10. Provide male plug to supply 110VAC into the controller
11. Run/Stop button

C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

D. Emergency Power Operation: (Battery Lowering 10-DOC) When the loss of normal power is detected, a battery lowering feature is to be activated. The elevator will lower to a predetermined level and open the doors. After passengers have exited the car, the doors will close and the car will shutdown. When normal power becomes available, the elevator will automatically resume operation. The battery lowering feature is included in the elevator contract and does not utilize a building-supplied standby power source.

E. Special Operation: Not Applicable

2.10 HALL STATIONS

A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.

1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.

a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: Not Applicable

D. Hall lanterns: Not Applicable

E. Special Equipment: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.

C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code.

D. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42'' minimum, (48'' minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.

1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.

2. Comply with the National Electrical Code for electrical work required during installation.

B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment,

inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

I. Lubricate operating parts of system, where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided.

Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
    1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 1

    1. Elevator Model: endura MRL Twinpost above-ground 2-stage

    2. Elevator Type: Hydraulic Machine Room-Less, Passenger

    3. Rated Capacity: 2500 lbs.

    4. Rated Speed: 140ft./min.

    5. Operation System: TAC32H

6. Travel: 16'-10''
7. Landings: 2 total
8. Openings:
    a. Front: 2
    b. Rear: 0
9. Clear Car Inside: 6'-8'' wide x 4'-3'' deep
10. Inside clear height: 7'-4" standard
11. Door clear height: 7'-0" standard
12. Hoistway Entrance Size: 3'-6'' wide x 7'-0" high
13. Door Type: One-speed Center opening
14. Power Characteristics: 208 volts, 3 Phase, 60 Hz.
15. Seismic Requirements: No
16. Hoistway Dimensions: 8'-4'' wide x 5'-9'' deep Minimum
17. Pit Depth: 4'-0''
18. Button & Fixture Style: Traditional Signal Fixtures
19. Special Operations: None

3.09 SPECIAL CONDITIONS (Note: Add Special Conditions as Needed)

END OF SECTION

SECTION 22 45 17A
EMERGENCY EYE/FACE WASH AND SHOWER EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY:

A. Section includes: Emergency shower and eyewash.

B. Related section:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.02 REFERENCES:

A. American National Standards Institute (ANSI):

1. Z358.1 – Emergency Eyewash and Shower Equipment.

2. Z535.1 – Safety Color.

C. American Society of Mechanical Engineers (ASME).

D. National Electrical Manufacturers Association (NEMA).

E. National Fire Protection Association (NFPA).

F. Occupational Safety and Health Administration (OSHA).

G. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS:

A. Shop drawings.

B. Product Data:

1. Submit manufacturer's product literature information for products specified.

2. Manufacturer's Installation Instructions.

C. Operation and Maintenance Data.

D. Warranty.

1.04 QUALITY ASSURANCE:

A. Manufacturer qualifications: Show evidence that the firm has been engaged in producing such materials and products for at least 5 years and that the product submitted has a satisfactory performance record of at least 5 years.

B. Installer qualifications: Installer shall have 3 years' experience in installing these materials for similar projects and shall be approved by the manufacturer prior to bidding of the project.

C. Regulatory requirements:
1. As applicable, equipment of this Section shall comply with requirements of public agencies of the state where the project is located including ASME, NFPA, OSHA, UL.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Packing and shipping: Deliver to the job site in manufacturer's original containers.

B. Delivery: After wet operations in building are completed.

C. Storage and protection:

1. Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

2. Keep materials dry until ready for use.

3. Keep packages of material off the ground, under cover, and away from sweating walls and other damp surfaces.

4. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

PART 2 PRODUCTS

2.01 EMERGENCY SHOWERS AND EYE/FACE WASHES:

A. General design requirements:

1. Combination unit emergency shower with eye/face wash:
    a. Floor mounted fixture consisting of pipe standard, showerhead assembly, and eyewash assembly.
    b. Provide stanchion and floor flange, with interconnecting piping.
    c. Provide shower/eyewash unit with integral controls to alarm the system is in use.
        1) Flow switch:
            a) Construction:
                (1) NEMA Type 4.
                (2) Brass or Type 316 Stainless Steel.
            b) Type: Paddle switch or similar displacement technology.
            c) Alarm Contacts: Double pole, double throw contacts rated at 2.0 Amps at 120VAC configurable for either Normally Open or Normally Closed.
        2) Control Panel:
            a) Construction:
                (1) NEMA Type 4.
                (2) Cast aluminum or steel Box with 3 conduit hubs.
                (3) Stainless steel cover plate.
            b) Silence/On – Off switch:
                (1) NEMA Type 4.
                (2) Maintain position, black, with nameplate.
                (3) 1 set of auxiliary contacts.
            c) Power: 0.6 Amps at 120VAC.
        3) Strobe:
            a) Construction:
                (1) NEMA Type 4.
                (2) 120VAC, AMBER Flashing LED.
        4) Horn:
            a) Construction:
                (1) NEMA Type 4.
                (2) 90dB at 10 feet Audible alarm.
2. Showerhead flow: 20.0 gallons per minute flow, minimum.
3. Eye/face wash flow: 3.0 gallons per minute flow, minimum.
4. Meet or exceed all requirements of ANSI Z358.1.
5. Provide ANSI compliant identification sign and markings.

B. Combination unit emergency shower and eye/face wash:

1. Manufacturers: One of the following:
    a. Haws, Model No. 8309.
    b. Guardian Equipment, Model No. G1950HFC.
    c. Bradley, Model No. S19-310AC.
2. Pipe standard:
    a. 1-1/4 inch hot-dip galvanized steel pipe, and fittings with interconnecting piping, stanchion, and 9-inch diameter floor flange.
    b. Corrosion protection: Provide Haws "-CRP" or Guardian Equipment "EC" epoxy protective coating in corrosive environments.
3. Shower head:
    a. Material and size: ABS plastic, 10-inch diameter.
    b. Valve and actuator: Stay open chrome plated brass ball valve equipped with stainless steel ball and stem operated by a rigid stainless-steel pull rod.
4. Eye/face wash receptor:
    a. Valve and actuator: Stay open chrome plated brass ball valve with stainless steel ball and stem operated by a stainless steel or epoxy coated aluminum push handle and foot treadle.
    b. Spray head(s): ABS plastic or polypropylene eye/face wash type heads, with integral flip top protective dust covers releasing with water pressure.
    c. Receptor bowl: Stainless steel; 11 inches diameter.
5. Supply: 1-1/4 inch Industrial Piping Systems (IPS).
6. Waste: 1-1/4 inch IPS.

C. Freeze resistant combination unit emergency shower and eye/face wash:
1. Manufacturers: One of the following:
    a. HAWS, Model No. 8317CTFP.
    b. Guardian Equipment, Model No. GFR3100.
    c. Bradley, Model No. S19-300T.
2. Pipe standard:
    a. 1-1/4 inch galvanized steel pipe and fittings, wrapped with self-regulating heat cable.
    b. Encase piping and fittings in UV resistant ABS plastic jacket with internal foam insulation; 5 inch diameter floor flange.
3. Shower head:
    a. Material and size: ABS plastic, 10-inch diameter.
    b. Valve and actuator: Chrome plated brass stay open steel ball valve actuated by rigid stainless steel pull rod.
4. Eye/face wash:
    a. Valve and actuator: Stay open chrome plated brass ball valve with stainless steel ball and stem operated by a stainless steel or epoxy coated aluminum push handle.

b. Heads: Twin ABS plastic or polypropylene soft-flow eye/face wash type heads, with integral flip top protective dust covers releasing with water pressure.

C. Eye/face wash – wall mounted (ADA compliant):

1. Manufacturers: One of the following:
    a. Haws, Model No. 7752WC.
    b. Guardian Equipment, Model No. GBF1721.
    c. Bradley, Model No. S19-220BF.
2. Skirt: Stainless steel.
3. Bowl: Stainless steel, 11-1/4-inch diameter.
4. Heads: Chrome-plated brass spray head assembly with eye wash heads and protective spray head covers.
5. Stream control: Integral flow control for steady flow under varying water-supply conditions.
6. Other features: Stay-open ball valve manually operated by stainless steel push flag handle. Provide 1/2 inch IPS supply, 1-1/4 inch IPS drain, and 1-1/2 inch satin chrome-plated trap.

D. Safety shower tester:

1. Manufacturers: One of the following:
    a. Haws, Model No. 9010 with No. 9009.
    b. Guardian Equipment, Model No. AP250-005.
    c. Bradley, Model No. S19-330ST.
2. Kit includes:
    a. Minimum 5 gallon plastic bucket
    b. 7 foot long watertight 12-gallon translucent vinyl plastic bag for attaching over drench showerhead.
        1) Bag shall have drawstring at top and be hemmed at bottom.
    c. Testing record card.

F. Safety shower tepid water mixing valves:

1. Manufacturers: One of the following or equal:
    a. Haws, Model No. 9201 Series.
    b. Guardian Equipment, Model No. G3800 Series.
2. General requirements:
    a. Provide 1 mixing valve for each safety shower unit or group of safety shower units mounted within 100 feet of each other.
3. Tepid water system to provide a minimum of 20 gallons per minute for shower and 3 gallons per minute for eye/face wash of water for a period of at least 15 minutes at a delivery temperature of 80 to 85 degrees Fahrenheit.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install products in accordance with manufacturers' recommendations.

B. Install fixed equipment in accordance with manufacturer's instructions.

3.02 PROTECTION:

A. Repair or replace defective equipment with new.

END OF SECTION

SECTION 22 45 18A

Double Wall High Intensity Polyethylene Storage Tanks

PART 1 GENERAL

1.01 REQUIREMENTS:

1. The CONTRACTOR shall provide SAFE-Tank® double wall high density cross-linked polyethylene tanks and accessories per section 2.05, complete and in place, in accordance with the Contract Documents.
2. Unit Responsibility: The CONTRACTOR shall be responsible for furnishing the SAFE-Tank® double wall tank(s) and its accessories for chemical storage as indicated.

1.02 REFERENCES, CODES AND STANDARDS:

A. American Society of Testing Materials (ASTM).

1.	D638	Tensile Properties of Plastics
2.	D883	Standard Definitions of Terms Relating to Plastics
4.	D1505	Density of Plastics by the Density-Gradient Technique
5.	D1525	Test Method for Vicat Softening Temperature of Plastics
6.	D1693	ESCR Specification Thickness 0.125" F50-10% Igepal
7.	F412	Standard Terminology Relating to Plastic Piping Systems

B. ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings

C. Building Code: International Building Code, IBC 2009

D. ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure)

E. ASTM D-1998, Standard Specification for Polyethylene Upright Storage Tanks

1.03 SUBMITTALS:

A. Shop Drawings: Shop drawings shall be approved by the engineer or contractor prior to the manufacturing of the SAFE-Tank® double wall tank(s). Submit the following as a single complete initial submittal.
Sufficient data shall be included to show that the product conforms to Specification requirements. Provide the following additional information:

1. SAFE-Tank® double wall tank and Fitting Material
   a. Resin Manufacturer Data Sheet
   b. Fitting Material
   c. Gasket style and material
   d. Bolt material
2. Dimensioned Tank Drawings
   a. Location and orientation of openings, fittings, accessories, restraints and supports.
   b. Details of manways, flexible connections, and vents.

3. Calculations shall be stamped and signed by a registered, third party engineer in the state of the installation.
   a. Tank restraint system. Show seismic and wind criteria.

B. Manufacturer's warranty

C. Manufacturer's unloading procedure (see Poly Processing Company Installation Manual)

D. Manufacturer's installation instructions (see Poly Processing Company Installation Manual)

E. Supporting information on Quality Management System.

F. Manufacturer's Qualifications: Submit to engineer a list of 5 installations in the same service as proof of manufacturer's qualifications.

G. Electrical heat tracing and foam insulation data sheets as required.

I. Factory Test Report
   1. Wall thickness verification.
   2. Fitting placement verification.
   3. Visual inspection
   4. Impact test
   5. Gel test
   6. Hydrostatic test

1.04 QUALITY ASSURANCE:

A. The Contractor shall supply SAFE-Tank® double wall tanks of the high density cross-linked polyethylene. Tanks furnished under this Section shall be supplied by Poly Processing Company or approved equal who has been regularly engaged in the design and manufacture of chemical storage tanks for over 10 years.

B. Tanks shall be manufactured from virgin materials.

1.05 WARRANTY:

A. The warranty shall be provided for a 5 year full replacement warranty.

PART 2 PRODUCTS

2.01 GENERAL:

A. Tanks shall be rotationally-molded, high density cross-linked polyethylene, double wall, Safe-tank®, flat bottom tanks -. The assembly consists of one cylindrical, closed top inner primary tank and one cylindrical, open top containment outer tank. Each tank is a rotationally molded one-piece seamless constructed tank. The

SAFE-Tank® tanks are designed for above-ground, vertical installation and are designed to store approved chemicals at atmospheric pressures. The assembly shall be designed to prevent rainwater and debris from entering the containment tank. Tanks shall be adequately vented as prescribed in Poly Processing Company's Technical Bulletin, Venting-Design for ACFM (air cubic feet per minute). Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories. Tanks shall be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

2.02 MANUFACTURER:

A. Tanks shall be manufactured by Poly Processing Company.

B. Equipment from alternate manufacturers shall not be acceptable unless pre-approved two weeks prior to bid date per Section 01 62 00 Substitutions and Product Options.

2.03 POLYETHYLENE STORAGE TANKS:

A. Service: Chemical storage tanks shall be suited for the following operating conditions:

B. High Density Cross-linked Polyethylene resin used in the tank manufacture shall be Poly CL™ or equal and shall contain ultraviolet stabilizer as recommended by resin manufacturer. Where black tanks are indicated, the resin shall have a carbon black compounded into it. The tank material shall be rotationally molded and be a resin that is commercially available at the time of tank manufacture.

C For sodium hypochlorite, sulfuric acid, and other oxidizing chemicals, tank resin shall include an antioxidant polyethylene system (OR-1000) with four times the antioxidant properties of a standard polyethylene bonded to the interior surface during the manufacturing process.

D. **Wall thickness** for a given hoop stress is to be calculated in accordance with ASTM D 1998. In NO case shall the tank thickness be less than design requirements per ASTM D 1998.

1. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

$T = P \times OD/2SD$ or $0.433 \times SG \times H \times OD/2SD$

Where:

	T	=	wall thickness, in
	P	=	pressure, psi
	SG	=	specific gravity, gm/cc
	H	=	fluid head, ft
	OD	=	outside diameter, ft
	SD	=	hydrostatic design stress

a. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187" thick.

2. On closed top tanks the top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall. In most cases, flat areas shall be provided for attachment of large fittings on the dome of the tank.
3. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be:

Tank Diameter, ft	Min Knuckle Radius, in
less than or equal to 6	1
greater than 6	1-1/2

4. Tanks with 3000 gal capacity or larger shall have at least 3 lifting lugs. Lugs shall be designed for lifting the tank when empty.
   a. Unless otherwise indicated by Contract drawings, for indoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with an emergency pressure relief device or SAFE-Surge™ Manway with pressure relief at 6" water column to prevent over-pressurization. The SAFE-Surge manway shall be chemically compatible with the chemical being stored. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.
   b. Unless otherwise indicated by Contract drawings, for outdoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with Poly Processing Company's F.S.2650® combined manway and vent to prevent over pressurization of tank. Manway must be capable of relieving a volume flow rate of up to 2650 ACFM. Gaskets shall be closed cell, cross- linked polyethylene foam, Viton, or EPDM materials.
   c. Unless otherwise indicated, tanks less than 2000 gallons in non-pneumatic applications shall have a manway cover 17-in or smaller of Polyethylene material with a coarse thread. Gaskets shall be closed cell, cross-linked polyethylene foam, viton or EPDM materials.

      NOTE: Tanks must be vented to allow for performance at atmospheric pressure, in accordance with the following matrix:

Venting Requirements For Polyethylene Tanks

Mechanical Pump Fill	**Pneumatic Fill**								
IF ≤ 1000 gallons	**IF** - Vent length ≤ 3 feet			**IF -** Vent length > 3' and ≤ 30'			**IF** - Scrubber Application		
Vent size should equal size of largest fill or discharge fitting	**AND - Vent** screen mesh size ≥ 1/4" or no screen used			**AND -** 3 or less 90° elbows with no other restrictions or reduction in pipe size			**Vent pipe size throughout scrubber system CANNOT be reduced!** Centerline of dispersion pipe not to be submersed > 6 inches		
IF > 1000 gallons	**Emergency Pressure Relief Cover Required**			**Emergency Pressure Relief Cover Required**			Perforated dispersion pipe must be same diameter or larger, as vent. Sum of perforations ≥ cross sectional area of pipe		
Vent size should exceed the largest fill or discharge fitting by 1 inch	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size
	2"	2"	4"	2"	2"	6"	2"	2"	6"
	3"	2"	6"	3"	2"	6"	3"	2"	8"
	3"	3"	6"	3"	3"	8"	3"	3"	10"

(2) 2 inch vents **DO NOT EQUAL** 4 inch venting capacity rev. Nov 2006

For detailed venting guidelines, please visit our Technical Resources at www.polyprocessing.com

E. Tank colors shall be natural (un-pigmented), black (compounded), or as specified by the ENGINEER with written agreement by the tank manufacturer.

2.04 TANK ACCESSORIES:

A. Ladder:

1. [Painted carbon steel], [fiberglass], [galvanized carbon steel] or [stainless steel] access ladders shall be provided with the polyethylene chemical storage tanks at locations as shown. Safety cages shall be added to ladders as required, per OSHA.
2. Ladders must be secured to the tank and secured to the concrete to allow for tank expansion/ contraction due to temperature and loading changes. Use proper chemical resistant materials when anchoring to tank dome or sidewall. See Poly Processing Company's Tank Installation Manual.
3. All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.

B. RESTRAINT SYSTEM:

1. Metal components to be [galvanized], [stainless steel], or [painted clips], edge softeners, and tension ring with [stainless steel], [galvanized] cables and clamps.
2. Tank restraint system shall be supplied and the design of same certified by a Structural Engineer registered in the State of tank installation. Design shall conform to the most recent edition of the IBC code for seismic and wind load. Anchor bolts as required by the calculations shall be supplied by the tank manufacturer.

C. HEAT TRACING:

1. Heat tracing system for temperature maintenance shall be SilcoPad® tank heating systems designed to maintain a desired product temperature, not to exceed 100 degrees F. Each system shall include tank heating pads and a temperature controller. The quantity and type of SilcoPad® is determined by the size of the tank, the desired temperature maintenance and environmental conditions. Systems shall be available in 30, 60 or 100 degrees F. Tanks are

supplied with the heating panels and a controller installed by Poly Processing Company. Power supply to be the only field installation required.

a. Pads to operate on 120 vac single phase with a maximum power density of 0.5 watts/sq.inch.

b. Silicone pad heaters must fully comply with Article 427-23 (b) of the National Electric Code.

c. Temperature controller to be supplied with two electronic thermostats switching the heating system via one solid state relay. Primary thermostat to control desired product temperature and secondary thermostat to provide over temperature protection at 150 degrees F.

D. INSULATION:

1. Insulation used shall be polyurethane foam with a density of 2.5 lb/ft3 with a minimum an "R" value of 6.3/in. The foam shall be applied with a nominal thickness of 2" to the external tank surfaces except the tank bottom.

2. Upon completion of application and curing of the insulation, 2 full coverage coats of latex mastic coating shall be applied to the surface of the insulation in such manner as to seal the insulation from the outside environment.

2.05 TANKS:

A. Tank Schedule per the following specifications

Note 1: Approximate overall height is measured along the straight cylindrical portion of the tank and includes the dome top.

B. Fittings

1. Tank fittings shall be according to the fitting schedule in 2.05B above. Threaded fittings shall use American Standard Pipe Threads. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.
2. Bolted flange fittings shall be constructed of one 150 lb. flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts to have chemical resistant polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. Stud bolt heads are to be color coded for visual ease of identifying the bolt material by onsite operators. Green- 316 Stainless Steel, Black- Titanium, Red- Alloy C-276, Blue- Monel. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.
3. For sodium hypochlorite and sulfuric acid storage, Bolted One-Piece Sure Seal (B.O.S.S.), double flange fittings constructed of virgin polyethylene shall be supplied. Bolts will be welded to a common backing ring and encapsulated with polyethylene preventing fluid contact with the metal

material. Flange will have one full face gasket to provide a sealing surface against inside tank wall. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.

4. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be PVC or material compatible with the chemical stored.
5. U-Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). U-vents shall be sized by the tank manufacturer and be furnished complete with insect screen if required (Insect screen lessens the vent capacity by 1/3) in accordance with the venting schedule listed above.
6. On dual wall tank(s) greater than 1000 gallons, bottom fitting(s) must be designed to maintain 110% secondary containment integrity. Bottom containment fitting must include PTFE expansion joint designed to accommodate movement of primary tank in design accordance with ASTM-D 1998 tolerances. All secondary containment fittings and parts shall be resistant to chemical fume corrosion. Fitting shall include the option to connect a secondary containment pipe over primary pipe.
7. All fittings on the 1/3 lower sidewall of tanks with capacities $\geq$ 1000 gallons shall have 100% virgin PTFE Flexijoint® expansion joint. Expansion joint to have 3 convolutions, stainless steel limit cables, FRP composite flanges and meet the following minimum performance specifications. Galvanized parts will not be accepted.

   Expansion joints to meet the following minimum performance requirements:

   Axial Compression ≥ 0.67”
   Axial Extension ≥ 0.67”
   Lateral Deflection ≥ 0.51”
   Angular Deflection ≥ 14º
   Torsional Rotation ≥ 4º

2.06 LEVEL INDICATION:

A. Float Indication: The level indicator shall be assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, clear UV resistant PVC sight tube EnviroKing® by C.F. Harvel, and necessary pipe supports. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time. Indicator shall be neon orange color for visual ease for onsite operators.

B. Ultrasonic Level Indicator: The ultrasonic level indicator shall be a Flowline ultrasonic level transmitter, level controller with one 4-20 mA or 0-10 VDC continuous level input and NEMA 4X box to be supplied by tank manufacturer.

2.07 FACTORY TESTING:

A. Material Testing

1. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.
2. Degree of Crosslinking. Use Method C of ASTM D 1998- Section11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

B. Tank Testing

1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.
2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.
3. Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING:

A. The tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving. AVOID sharp objects on trailers.

B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.

C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit. If damage has occurred, Poly Processing Company shall be notified immediately.

3.02 INSTALLATION:

A. Install the tanks in strict accordance with Poly Processing Company's Tank Installation Manual and shop drawings.

B. Installation will be inspected by manufacturer to verify system flexible connections, venting and fittings are properly installed. In addition to on-sight inspection tank system(s) to be reviewed using tank manual check list as supplied by manufacture as listed below.

C. Manufacturer to provide 1 hour training session to prepare operators to service and maintain the tank system. Included in training session will be (#) training manuals.

D. Manufacturer's trained technician to do an onsite inspection of installation. Inspection will verify chemical application, plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A verification of proper installation certificate will be supplied when equipment passes installation checklist.

E. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program.

3.03 FIELD TESTING:

A. All tanks will be hydro-tested for 24 hours prior to commissioning.

End of Section

No specifications on this page for formatting purposes.

SECTION 23 0010

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS AND SUPPLEMENTAL GENERAL PROVISIONS

A. The "General Conditions" and "Supplementary Conditions" are by reference made a part of this section and shall apply to each and every heading as though included herein.

B. In the event of conflict, the requirements of the "General Conditions" and "Supplementary Conditions" will take precedence over these "General Requirements".

1.02 GENERAL

A. The Contractor shall provide all plans, labor, equipment, appliances and materials, and shall perform all operations in connection with the installation of the mechanical work in accordance with the Specifications, applicable drawings, and the conditions specified above.

B. Contractor shall provide all equipment required and usually furnished in connection with such work and systems whether or not specifically mentioned or specifically indicated on the drawings.

1.03 COMMISSIONING

A. The Contractor shall provide all system commissioning services as required by section C408 of the 2015 International Energy Conservation Code (IECC). Mechanical systems shall comply with IECC section C403.

B. Commissioning, as outlined in IECC section C408 shall include the following:

1. A commissioning plan.

2. Air systems balancing.

3. Functional performance testing for all mechanical equipment, controls and economizers.

4. A preliminary commissioning report.

5. Final documentation including drawings, O&M manual(s), T&B report, and final commissioning report.

1.04 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

A. Refer to other sections of the specifications for construction phasing and time increments.

B. The Contractor shall obtain and pay for all required utility connections, utility extensions and/or relocations and shall pay all costs and inspection fees for all work included herein.

1.05 APPLICABLE CODES AND STANDARDS

A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of the Specifications, except as may be hereinafter modified in these Specifications and associated drawings.

B. Latest edition of the National Fire Protection Association Standards (NFPA):

1.	NFPA No. 70	National Electrical Code
2.	NFPA No. 90A	Installation of Air Conditioning and Ventilating systems
3.	NFPA No. 91	Exhaust systems of Air Conveying of Gases, etc.
4.	NFPA No. 96	Ventilation control and Fire Protection of Commercial Cooking Operations
5.	NFPA No. 101	Safety to Life from Fire in Buildings and Structures
6.	NFPA No. 255	Test of Surface Burning Characteristics of Building Materials

C. United States of America Standards Institute (ASA) Standards:

1.	A40.8	National Plumbing Code
2.	B31.1 & B31.1a	Code for Pressure Piping

D. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.

E. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) 1985: All applicable manuals and standards.

G. Air Moving and Conditioning Association (AMCA): All applicable manuals and standards.

H. American Society of Testing and Material (ASTM): All applicable manuals and standards.

I. American Water Works Association (AWWA): All applicable manuals and standards.

J. National Electrical Manufacturer's Association (NEMA): All applicable manuals and standards.

K. City Fire Department as applicable to construction of this site.

L. City and State Building Codes.

M. State of (Texas) Occupational Safety Act: Applicable safety standards.

N. Occupational Safety and Health Act (OSHA).

O. State of (Texas) Energy Conservation Construction Code.

P. All work shall be in accordance with all regulations and requirements of the State of Texas Architectural Barriers Act (TAS).

Q. Refer to Specifications sections hereinafter bound for additional codes and standards.

R. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. All material shall be listed by the Underwriter's Laboratories, Inc., as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.

S. All equipment provided and all installation methods shall meet all applicable requirements of the International Energy Conservation Code.

T. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by other specifications of the Contract Documents, providing no work or fabrication of materials has been accomplished in a manner of non-compliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.06 CONTRACT DOCUMENTS

A. These specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, switch controls, circuits, lines, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If the Contractor deems any departures from the drawings necessary, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance.

C. There are intricacies of construction that are impractical to specify or indicate in detail; however, in such cases the current rules of good practice and applicable specifications shall govern.

D. It is the Contractor's responsibility to properly use all information found on the Civil, Architectural, Structural, Mechanical, Plumbing, and Electrical drawings where such information affects his work.

E. All dimensional information related to new structures should be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.

F. The interrelation of the specifications, the drawings, and the schedules is as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.

G. Should the drawings or specifications disagree within themselves, or with each other, the better quality of greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect in writing, shall be performed or furnished. Figures indicated on drawings govern scale measurements and large-scale details govern small-scale drawings.

1.07 SPACE AND EQUIPMENT ARRANGEMENT

A. The size of fire protection, plumbing, mechanical, and electrical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared to indicate a suitable arrangement.

B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

C. Maintain all code required clearances for equipment access.

1.08 FABRICATION DRAWINGS

A. Contractor shall submit ductwork fabrication and hydronic piping shop drawings for review by the Architect and Engineer. Fabrication drawings shall be fully coordinated with ALL other trades and with existing conditions.

B. All required shop drawings, except as hereinafter specified, shall be prepared at a scale of not less than 1/8 in. equal to 1 ft. for floor plans and 1/4 in. equal to 1 ft. for mechanical rooms.

1.09 SUPERVISION

A. Each contractor shall keep a competent superintendent or foreman on the job at all times necessary for the timely and proper completion of the work.

B. It shall be the responsibility of each superintendent to study all drawings and familiarize himself with the work to be done by other trades. He shall coordinate this work with other trades, and before material is fabricated or installed, make sure that his work will not cause an interference that cannot be resolved without major changes to the drawings. If a conflict between trades arises that cannot be resolved at the jobsite, the matter shall be referred to the Architect for his ruling.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall prepare, in triplicate for the Owner's Manual, complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc., for each item of equipment. Include copies of all equipment warranties.

B. In addition, the Contractor shall provide the services of a competent engineer or a technician acceptable to the Architect to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of not less than 4 hours to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, stating the dates of instruction and the personnel to whom instructions were given. The Contractor shall be responsible for proper maintenance until the instructions have been given to the Owner's maintenance personnel.

1.11 GUARANTEE

A. All work and equipment shall be guaranteed for a period of one year from the date of substantial completion.

B. Guarantee shall be for all labor and materials.

C. Certain items for equipment shall have additional or extended warranties when so specified.

1.12 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be of current U.S. manufacture, new, free from all defects, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, workmanlike appearance. Materials, and/or equipment damaged in shipment, or otherwise damaged prior to installation, shall not be repaired at the job site, but shall be replaced with new materials and/or equipment.

B. The responsibility for furnishing the proper equipment and/or material, and to see that it is installed as intended by the manufacturer rests entirely upon the Contractor, who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.13 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to NFPA 255, latest edition. The classification shall not exceed No. 2, with the range of indices between 0 to 25 for these Classifications as listed in the Federal Specifications. Modifications shall be made to insulating materials, etc., as required to comply with the Federal Specification.

1.14 LARGE APPARATUS

A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.15 FLOOR AND CEILING PLATES

A. Except as otherwise noted, provide chrome plated brass floor and ceiling plates around all pipes, conduits, ducts, etc., passing exposed through walls, floors, or ceilings, in any spaces, except under floor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4 in. above finished floor. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have plates made to fit accurately at all floor, wall and ceiling penetrations.

1.16 SLEEVES, INSERTS AND FASTENINGS

A. Proper openings through floors, walls, roofs, etc., for the passage of piping, ductwork, etc., shall be provided. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect.

B. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

C. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeves shall be 1/4 in., except that the minimum clearance shall be 2 in. where piping contacts the ground. Sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves through floors shall be extended 2 in. above finished floor.

D. Above grade and dry location sleeves shall be constructed from 20 to 22 gauge galvanized steel. Sleeves passing through walls or floors on or below grade and/or moist areas such as mechanical rooms shall be constructed of galvanized steel Schedule 40 pipe and shall be designed with suitable flange in the center of the floor or wall to form a waterproof passage. After the pipes have been installed in the sleeves, void space around the pipe shall be sealed with "Link-Seal" modular wall and casing seals as manufactured by Thunderline Corporation.

E. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.

F. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are acceptable for general use, and will only be permitted where specifically acceptable to the Architect.

G. Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

H. Vermin Proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be sealed with a continuous bead of sealant.

I. The space around piping, ductwork, etc., penetrating walls, ceilings and floors that define air plenums shall be sealed airtight in an acceptable manner. Ceiling plenums used for return air are considered air plenums.

1.17 ACCESS DOORS

A. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed shutoff or service valves, strainer, unions, pressure reducing valves, trap primers, water hammer arrestors, heat trace cable junction boxes, and other items of concealed mechanical equipment. All access door locations are not shown on the drawings. It is the Contractor's responsibility to provide access doors at all locations required.

B. Access doors mounted in painted surfaces shall be equal to Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surfaces of the adjacent finishes. Access doors mounted on tile surfaces shall be stainless steel materials. Access doors shall be minimum of 18 in. x 18 in. in size.

1.18 CONSTRUCTION REQUIREMENTS

A. The Civil, Architectural, Structural, Fire Protection, Mechanical, Plumbing, and Electrical plans and specifications including the General Provisions, Supplemental General Provisions, and other pertinent documents issued by the Architect, are a part of these specifications and the accompanying mechanical drawings, and shall be complied with in every respect. All the above is included in the Contract Documents, and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation due to omission of architectural, structural and electrical details from the mechanical drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed and thereby to provide an integrated satisfactory operating installation.

D. The mechanical and associated drawings are necessarily diagrammatic in character and cannot show every connection in detail or every pipe or equipment in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate pipe hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

E. When the mechanical drawings do not give exact details as to the elevation of pipe, ducts, etc., physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping and duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner, and the plans do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain in order to insulate will not be permitted.

F. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. Piping, ductwork, valve stems, etc., shall not block service space.

1.19 MECHANICAL SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: "SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES" for submittal definitions, requirements, and procedures.

B. Submittal of Shop Drawings, product data, and samples will be accepted only when submitted by The Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

C. Submit Shop Drawings, product data, and samples on items indicated in the individual sections.

D. Shop Drawings and submittal data shall not be used as requests or proposals for alternate equipment or materials. Refer to Item "Product Options and Substitutions" elsewhere in this section.

E. THIRD PARTY CERTIFICATION: All Packaged equipment shall be independently Third Party labeled as a system for its intended use by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399, as well as NFPA Pamphlet #70, National Electric Code (NEC), Article 90-7.

1.20 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and the Division 01 Section "PRODUCTS AND SUBSTITUTION" for requirements in selecting products and requesting substitutions.

B. Standards for Materials:

1. These specifications indicate a standard for all materials incorporated into the work, with manufacturer's names and catalog numbers used to establish a grade and quality of materials and equipment. The manufacturer listed on the equipment schedules, or named first in the specifications, is the one on whose equipment the layout is based. Other named manufacturers must meet the indicated performance and space requirements.

2. The "approved equal" clause used in these specifications is to permit the proposal of unnamed manufacturer's products for the work, and the Architect decision concerning equal products is final.

3. Considerations as to determination of equal products include, but are not limited to, the following:

Materials	Physical size
Workmanship	Weight
Gauges of Materials	Appearance
Available Local Service Personnel	Performance
Previous successful installations	Capacity
Delivery Schedules	Required Equipment Clearances

C. Requests for substitutions for equipment, materials and apparatus listed in Division 23 Sections must be submitted in writing a **MINIMUM OF 10 DAYS** prior to the scheduled bid date. Such requests must be accompanied by complete data to permit proper evaluation.

D. BIDS SHALL NOT BE BASED ON UN-APPROVED MATERIALS, EQUIPMENT, OR APPARATUS. UNAPPROVED MATERIAL, EQUIPMENT OR APPARATUS WILL NOT BE ACCEPTED.

E. Should electrical, water, drain, natural gas, structural support, or other similar requirements for alternate equipment, whether named in the specifications or approved as a substitution, be different from requirements for the products used in laying out the project, such changes shall

be the responsibility of the Contractor, and shall not result in extra charges to the Owner, Architect, or Engineer.

1.21 RECORD DOCUMENTS

A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for requirements. The following paragraphs supplement the requirements of Division 01.

B. Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.22 PAINTING

A. Field painting of mechanical equipment, duct systems, piping systems, etc., shall be accomplished under Division 09 of these specifications.

B. Protection of Factory-applied Finishes:

1. Factory-applied finishes on equipment and apparatus installed on the project shall be carefully protected.

2. At the conclusion of the work, and prior to final acceptance of the project, equipment and apparatus shall be thoroughly cleaned of all construction dirt, oil and grease smears, temporary labels, debris, paint droppings, etc.

3. Damaged factory finishes shall be restored to their original condition using procedures, materials and application techniques as set forth in Division 09 found elsewhere in these specifications.

1.23 CLEANING

A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for general requirements for final cleaning.

B. Refer to Division 23 Section: "TESTING, ADJUSTING, AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.

C. Name Plates:

1. All nameplates shall be protected from damage during the construction process.

2. At the conclusion of the work, the nameplates shall be carefully cleaned and left in a fully legible condition.

D. Removal of Rubbish: Each Contractor is responsible for the timely removal of rubbish and trash generated by his work, such as empty cartons, containers, materials crates, etc. Particular attention is called to residue that may present a potential tripping or injury hazard.

1.24 MOTORS AND DRIVES

A. Motors:

1. General: Motors shall be U/L-approved, with copper windings, and with a minimum Service Factor of 1.15. The nominal capacity shall exceed the brake horse-power requirements at duty schedules.

2. Motors 1/2 HP and smaller shall be 120-volt, single-phase with internal overload protection.

3. Motors 3/4 HP and larger shall be 208/230 -volt, 1 or 3-phase, unless scheduled or noted otherwise, and shall have thermal over-load cutouts in each phase as recommended by the motor manufacturer.

4. Motors shall be as manufactured by Century, General Electric, US Motors, Wagner, Westinghouse, or approved equal.

B. Drives:

1. Belts drives shall be rated for 150% of motor-rated horsepower.

2. Drive assemblies up to two (2) belts shall have adjustable motor sheaves with the mid-point of the adjustment range at the RPM required for the specified performance.

3. On drive assemblies with 3 or more belts, provide fixed motor sheaves for the specified RPM. Provide and install up to 2 pulley changes as necessary to achieve the required air quantities.

4. All multiple-belt drives shall be factory-marked-matched sets.

C. Specific requirements:

1. Provide high-efficiency motors for the following:

a. Air-Handling Units, as scheduled.

b. Ventilating Fans, as scheduled.

2. Efficiency ranges shall be as follows:

Nominal HP	Minimum Efficiency	Premium Efficiency

3	86.5	89.5
5	87.5	89.5
7.5	88.5	91.7
10	89.5	91.7
15	91.0	92.4
20	91.0	93.0
25	91.7	93.6
30	92.4	93.6
40	93.0	94.1
50, 60, 75	93.0, 93.6, 94.1	94.5, 95.0, 95.4
100	94.1	95.4

Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.

3. Variable Speed (Frequency) AC Drives:

   a. Where scheduled on the plans, provide and install variable speed (frequency) AC drives for motors.

   b. Variable speed (frequency) AC drives shall be as described in Section 23 8965 - MOTOR CONTROLLERS - of these Specifications.

4. Motor Starters and Controllers:

   a. Motor starters and controllers for fans, pumps, air-handling units, compressors, etc., which are not provided as an integral part of a factory-assembled package, shall be provided under Division 23 of the specifications. Refer to Section 23 8965 "MOTOR CONTROLLERS."

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer's materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

B. The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.

C. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions.

D. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriter's Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under these sections of the specifications conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.

E. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Observation.

F. Standard factory finish will be acceptable on equipment specified by model number; otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking, and no signs of rust creepage beyond 1/8 in. on either side of the scratch mark. Where rust-inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable, unless a specific coating is specified, except that coal tar or asphalt type coatings will not be acceptable, unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-6215.

G. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

H. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect of any discrepancy before performing any work. Adjustments to the work required, in order to facilitate a coordinated installation, shall be made at no additional cost to the Owner.

2.02 PROTECTION

A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

B. Take particular care not to damage the building structure in performing work. All finished floors, steel treads, and workmen or their tools and equipment shall cover finished surfaces to prevent any damage during the construction of the building.

C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final observation must be cleaned of rust and repainted as specified elsewhere in these specifications.

2.03 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

A. Each trade, subcontractor and/or contractor must work in harmony with the various other trades, subcontractors, and/or contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or contractor must pursue his work promptly and carefully as not to delay the general progress of the job. This Contractor shall work in harmony with contractors working under other contracts on the premises.

2.04 PRECEDENCE OF MATERIALS

A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the available space, and which will insure complete and satisfactory systems. Each Contractor shall be responsible for the proper fitting of his material and apparatus into the building.

B. Each Contractor shall so harmonize his work with that of the other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:

1. Building lines
2. Structural members
3. Soil and drain piping
4. Vent piping
5. Condensate piping
6. Refrigerant piping
7. Electrical bus duct
8. Supply ductwork
9. Return ductwork
10. Exhaust ductwork
11. Domestic hot and cold water piping
12. Electrical conduit

2.05 LOCATION OF OUTLETS IN ROOMS

A. All fire protection, plumbing, acoustical tile, diffusers, grilles, registers, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Those mechanical and electrical outlets shall be referenced to such features as wall and ceiling furrings, balanced border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the center of whole tiles. When locations of mechanical and electrical devices shown on the Architect reflected ceiling plans need to be modified, the final determination of the exact location of each outlet and the arrangement to be followed shall be acceptable to the Architect.

B. The drawings show diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with the other trades. The Architect reserves the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.

C. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability, and that he will install his work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete, and in good working order. If any of the requirements of the drawings and specifications are impossible of performance, or if the installation, when made in accordance with such requirements, will not perform satisfactorily, he shall report it to the Architect for correction promptly after discovery of the discrepancy.

2.06 CONNECTIONS FOR OTHERS

A. This Contractor shall rough-in for and make all gas, water, steam, sewer, etc., connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, along with actual measurements of the equipment connections, or as detailed.

B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.

C. Provide all air gap fittings where required. In each water line serving an item of equipment or piece of machinery, provide a shut-off valve. On each drain not provided with a trap, provide a suitable trap.

D. All pipefittings, valves, traps, etc., exposed in finished areas and connected to chrome-plated lines provided by others shall be chrome plated to match.

E. Provide all sheet metal ductwork, transition pieces, etc., required for a complete installation of vent hoods, exhaust hoods, etc., provided by others.

2.07 SMOKE DETECTORS

A. The contractor shall for each air handling system with 2000 CFM (nominal 5 Tons) or greater airflow, install UL-listed ionized smoke detectors in the main supply air duct and main return air duct and/or where shown on the drawing. Smoke detectors furnished by Division 26. Refer to Section 23 0512. Connect the detectors into the control circuit to stop the fan in the event of the presence of smoke.

1. System airflow included the total airflow of all units serving any single space and all units connected to the same return air plenum.

PART 3 - INSTALLATION

3.01 INSTALLATION METHODS

A. All pipes shall be concealed in pipe chases, walls, furred spaces, or above the ceiling, unless otherwise indicated.

B. Piping may be run exposed in mechanical rooms, janitors' closets, or storage spaces, but only where necessary. All exposed piping shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.

C. All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.

D. Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, in a manner to provide maximum above-floor clearance. Sleeves shall be as specified or as required.

E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run, exposed in machinery and equipment rooms, shall be installed parallel to the building plans, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.

F. There shall be no pipe joints nearer than 12 in. to a wall, ceiling, or floor penetration, unless pipe joint is the welded type joint.

G. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Architect and resolve the conflict, prior to erection of any work, in the area involved.

3.02 CUTTING AND PATCHING

A. Cut and patch openings through walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.

B. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills at locations acceptable to the Architect. Impact-type equipment will not be used, except where specifically acceptable to the Architect. Openings in Precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled or cast to exact size.

C. All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

D. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.

E. All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. No cutting, boring, or excavating, which will weaken the structure, shall be undertaken. NO STRUCTURAL MEMBER MAY BE CUT WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT.

3.03 ROOF PENETRATIONS AND FLASHING

A. Pipe and duct sleeves and flashings compatible with the roofing installation shall be provided for roof penetrations. Manufacturer of roofing materials shall approve methods and materials. Pitch pans are not acceptable.

B. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

C. Piping penetration flashings shall be specially made for metal roofs and shall be EPDM or neoprene compression molded rubber with corrosion resistant metal base. Flashings shall be by Portals Plus, Inc., Buildex Dektite, or approved equal.

3.04 FABRICATION OF PIPE

A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.

B. Piping shall follow as closely as possible the routes shown on plans, but shall take into consideration conditions to be met at the site.

C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval has been obtained.

D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which lines are connected.

E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage shall be removed. Pipe shall not be permitted to lie on the ground during storage. Pipe ends shall be sealed during storage.

3.05 IDENTIFICATION AND LABELING

A. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them.

B. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16 in. thick, 3-ply, with black surfaces and white core. Engraving shall be condensed gothic, at least 1/2 in. high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Equipment to be labeled shall include, but not be limited to, the following:

1. Air Handling Units
2. Exhaust Fans
3. Heat Pumps
4. Air conditioning control panels and switches
5. Motor controllers
6. Miscellaneous similar and/or related items.

C. The Contractor shall install identification tags to be affixed to those valves that have functions that are not obvious. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. The valve identification tags shall be brass discs, 2 in. in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.

3.06 TESTS AND INSPECTIONS

A. The Contractor shall, during the progress of the work and upon its completion, test his work and make all tests as required by the specifications, state, municipal and other authorities having jurisdiction of the work. Piping pressure tests shall be made before pipe is concealed or covered. Tests shall be made in the presence of authorities requiring tests. The Contractor shall pay all costs, inspection charges and fees required for the tests of his work.

B. The Contractor shall provide all apparatus, temporary piping connection, etc., required for tests. The Contractor shall take all due precautions to prevent damage to the building or its

contents incurred by such tests. The Contractor shall repair and make good at his own expense any damage caused by failures or leaks during the tests.

C. Leaks, defects or deficiencies shall be repaired and/or replaced, and tests shall be repeated until the test requirements are complied with fully.

D. All equipment shall be placed in operation and tested for proper automatic control before the final balancing of the system is started.

E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test condition, test results, specified results, and any other pertinent data. Data shall be delivered to the Architect.

3.07 COOPERATION AND CLEANUP

A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by his portion of the work.

3.08 CLEANING AND PAINTING

A. All equipment, piping, ductwork, grills, insulation, etc., in finished areas furnished and installed by the Contractor shall be painted. Finished areas include mechanical rooms, boiler rooms, and outside the building as well as occupied areas inside the building. Final painting is to be done by the General Contractor. This Contractor shall thoroughly clean all part of materials and equipment of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.

B. This Contractor shall thoroughly clean the finish on all parts of the materials and equipment with factory applied finishes. Exposed parts in equipment rooms, above crawl space slabs, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. If the finish has been damaged, the Contractor shall re-paint to the satisfaction of the Architect.

C. All canvas finishes shall be painted with one sizing coat if not already sized, containing a mildew resistant additive and Arabol adhesive prior to any other specified finish paint.

D. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during painting operation.

3.09 ELECTRICAL PROVISIONS OF MECHANICAL WORK

A. The extent of electrical provisions to be provided as mechanical work is indicated in other mechanical sections of the specifications, on the drawings and as further specified in this section.

B. Starters, Controllers: In general, mechanical work includes furnishing combination starters. Controllers are specifically included as electrical work when mounted in motor control centers. Electrical work includes installation, mounting and wiring of starters and controllers that are furnished as mechanical work. Free standing, large motor controllers shall be set in place, on pads, as mechanical work.

C. Electrical heating equipment shall be furnished complete with internal or integral fusing and subdivision of loads to comply with the NEC.

D. Wherever possible, match the elements of the electrical provisions of mechanical work with similar elements of the electrical work specified in electrical sections of the specifications.

E. Standards:

1. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards to definitions of terminology herein.

2. Comply with National Electrical Code (NFPA No. 70) for installation requirements.

3. Comply with National Electrical Contractors Association (NECA) "Standard of Installation".

3.10 TEMPORARY FACILITIES

A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.11 EQUIPMENT INSTALLATION REQUIREMENTS

A. All mechanical equipment shall be furnished and installed complete and ready for use.

B. All mechanical equipment and appliances shall be installed in a manner that all Code required access and services space is provided. Coordinate exact position of equipment and appliances with routing of new ductwork and piping, and with all existing conditions to provide required clearances.

1. Ensure that a minimum of 30” deep and 30” wide working space is provided in front of the control side of each appliance and piece of air moving equipment.

2. Ensure that air moving equipment and appliance in attics are installed so that they also have Code required clear passageway.

C. Others shall furnish certain kitchen, lab, or Owner process equipment. Contractor shall be responsible for furnishing and installing all items as required to make kitchen equipment complete operating systems. The Contractor shall furnish and install all auxiliary piping, valves, controls, control wiring, conduit, alarms, etc., required. All necessary devices, control wiring, conduit, etc., will not necessarily be shown on the drawings.

3.12 OWNER FURNISHED EQUIPMENT

A. The Contractor's responsibility shall include receiving and installing all Owner-furnished equipment.

END OF SECTION 23 0010

SECTION 23 0512

MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Refer to Section 26 0510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Refer to Section 22 0010 - BASIC PLUMBING REQUIREMENTS.

C. Refer to Section 23 0010 - BASIC MECHANICAL REQUIREMENTS.

1.02 SUMMARY

A. This Section describes the coordination between the Fire Protection, Plumbing, Mechanical and Electrical portions of the work.

B. This Section is included under the under the Division 22 portion of the Specifications as Section 22 0512, under the Division 23 portion of the Specifications as Section 23 0512, and under the Division 26 portion of the Specifications as Section 26 0512.

1.03 WORK INCLUDED

A. Responsibility: Unless otherwise indicated, motors and controls shall be furnished, set in place and wired in accordance with the following schedule. **This schedule may include equipment and systems that are not required for this project. Only the equipment and systems that are required on the drawings and/or specified elsewhere will be required by this section:**

ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
1. Equipment Motors	21/22/23	21/22/23	26
2. Magnetic Motor Starters			
a. Automatically controlled, with or without HOA switches	21/22/23	26	Notes 1,3,5
b. Automatically controlled, with or without HOA switches and furnished as part of factory wired equipment	21/22/23	22/23	Notes 1,3,5
c. Manually controlled	21/22/23	26	Notes 1,3,5
d. Manually controlled and furnished as part of factory wired equipment	21/22/23	26	Notes 1,3,5
e. Furnished in Motor Control Centers	26	26	Notes 1,3,5
3. Variable Speed (Frequency) AC Drives	22/23	26	Notes 1,4,5

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
4.	Line voltage thermostats, time clocks, etc., not connected to control panel systems	23	26	23
5.	Electric thermostats, time clocks, remote bulb thermostats, motorized valves, float controls, etc. which are an integral part or directly attached to ducts, pipes, etc.	22/23	22/23	22/23
6.	Temperature control panels and time switches mounted on temperature control panels	23	23	23
7.	Motorized valves, motorized dampers, solenoid valves, EP and PE switches, etc.	23	23	Note 1
8.	Alarm bells furnished with equipment installed by Division 22 or 23	22/23	22/23	22/23
9.	Wiring to obtain power for control circuits, including circuit breaker	21/22/23	21/22/23	21/22/23
10.	Low voltage controls	21/22/23	21/22/23	21/22/23
11.	Fire protection system (sprinkler) controls	21	21	Note 8
12.	Fire and smoke detectors installed on mechanical units and in ductwork	28	23	Note 8
13.	All relays required for fan shutdown, motorized dampers, smoke control devices, and other items integral with HVAC equipment to provide operation and control of HVAC equipment	23	23	Note 1
14.	Smoke dampers, and combination fire/smoke dampers	23	23	Note 7
15.	Boiler and water heater controls, boiler burner controls panels	22/23	22/23	22/23
16.	Pushbutton stations, pilot lights	22/23	22/23	22/23
17.	Heat Tape	21/22/23	21/22/23	26
18.	Disconnect switches, manual operating switches furnished as a part of the equipment	21/22/23	21/22/23	Notes 1,5
19.	Disconnect switches, manual operating switches furnished separate from equipment	26	26	26
20.	Multispeed switches	23	23	26
21.	Thermal overloads	21/22/23	21/22/23	21/22/23

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
22.	Control relays, transformers	21/22/23	21/22/23	21/22/23
23.	Refrigeration cycle, cooling tower and controls	23	23	23
24.	Tamper switches for fire protection (sprinkler) system	21	21	28
25.	Flow and/or pressure switches for fire protection (sprinkler) system	21	21	28
26.	Fire and jockey pump controllers and automatic transfer switch	21	21	Note 6
27.	Alarm bells or horns for fire protection (sprinkler) system	21	21	28
28.	Generator (underground) fuel tank	22	22	--
29.	Generator fuel level indicator	22	22	26
30.	Generator fuel piping from tank to generator	22	22	--
31.	Underground fuel tank leak detection and monitoring system	22	22	22

NOTES:

(1) Power wiring as defined in Section 26 2913 of the specifications shall be provided under Division 26; control wiring as defined in Section 26 2913 of the specifications shall be provided under Division 21/22/23.

(2) Wiring from alarm contacts to alarm systems provided by Division 26, wiring from auxiliary contacts to air handling system controls provided by Division 23. Division 26 shall provide power to smoke detector. Smoke detectors required for all air handling systems 2000 CFM or greater. Refer to other Division 23 specifications, Division 26 and Drawings for more specific requirements.

(3) For requirements for Magnetic Motor Starters, refer to Section 23 8965 - MOTOR CONTROLLERS.

(4) For requirements for Variable Speed (Frequency) AC drives, refer to Section 23 8965 - MOTOR CONTROLLERS.

(5) Disconnect switches, operating switches, starters and other similar items that are factory-mounted, as a part of complete assembly, shall comply with applicable provisions of the National Electric Code. All such disconnect switches shall be fused.

(6) Power wiring from energy source to controllers and automatic transfer switch shall be provided under Division 26. Interconnection power and control wiring from controllers and automatic transfer switch to pumps shall be provided under Division 21, 22 or 23 and conforming to Division 26 specifications. Control wiring from automatic transfer switch to generator starter shall be provided under Division 26.

(7) Division 26 will provide power to all smoke and combination fire/smoke dampers, and Division 28 will provide control for all such dampers using area smoke detectors.

(8) Wiring for sprinkler system controls to be provided by Division 21. Wiring from devices to Fire Alarm System to be provided by Division 28.

B. CONNECTIONS: Make all connections to controls that are directly attached to ducts, piping and mechanical equipment with flexible connections.

C. PRECEDENCE

1. In general, piping systems that require a stated grade for proper operation shall have precedence over other systems.

2. Precedence for pipe, conduit and duct systems shall be as follows.

   a. Building lines

   b. Structural members

   c. Soil and drain piping

   d. Vent piping

   e. Condensate piping

   f. Refrigerant piping

   g. Electrical bus duct

   h. Supply ductwork

   i. Return ductwork

   j. Exhaust ductwork

   k. Domestic hot and cold water piping

   l. Electrical conduit

3. Lighting Fixtures shall have precedence over air grilles and diffusers.

D. FINAL INSPECTION AND REPORT

1. At the completion of the work, there shall be a meeting of the Fire Protection, Plumbing, Mechanical, Electrical Fire Alarm and Temperature Control Contractors, representatives of mechanical and electrical equipment manufactures whose equipment was actually installed on the project, and similarly-involved individuals, who shall thoroughly inspect all systems, and who shall mutually agree that all equipment has been properly wired and installed, and that all temperature and safety controls are properly functioning. A written report of this meeting, listing those in attendance, and the companies that they represent, shall be filed with the Owner and Architect or Engineer.

END OF SECTION 23 0512

SECTION 23 0593

MECHANICAL TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 SUMMARY

A. Adjust and balance Mechanical Air systems.

B. Check each piece of operating equipment provided under Division 23.

C. Provide Balancing Report.

1.02 QUALITY ASSURANCE

A. Independent Subcontractor: All testing, adjusting and balancing shall be performed by a Testing, Adjusting and Balancing firm that is independent from the HVAC systems installer.

B. Balancing Work: Under direct supervision of AABC accredited testing organization certified supervisor.

1.03 REFERENCES

A. Reference Standards: Comply with AABC National Standards for Total System Balance, latest edition.

1.04 SUBMITTALS

A. Certificate: Before beginning work, submit certification of AABC certified supervisor and AABC firm certification in accordance with Section 23 0010.

B. Balancing Report: At completion of work, submit balancing report in accordance with Section 23 0010. After adjustments have been made submit three (3) copies of a complete detailed report on mechanical systems and their operation to include:

1. Blackline prints with air openings marked to correspond with data sheets and with thermometer locations clearly marked.

2. Data sheets showing amount of air handled at each opening, instrument used, velocity readings and manufacturer free area factors.

3. Equipment data sheets giving make, size, etc., of fans, motors and drives. Include supply fans, exhaust and recirculating fans.

4. Operating data including fan RPM, measured motor current and voltage BHP and CFM (total).

5. Equipment and operating data at each section of the unit and at the unit connection points including air temperatures entering and leaving coils (maximum air temperature rise), together with corresponding air flow and air pressure drop.

6. Equipment and operating data as required to show performance of H&V units, fan coils, cabinet heaters, unit heaters, temperature control devices, pumps and domestic hot water circulating systems.

7. A statement outlining any abnormal or notable conditions not covered in above data. Make special note of any discrepancies between tabulated data and specified conditions.

1.05 PROJECT CONDITIONS

A. Existing Conditions: Verify following conditions before proceeding with work:

1. Installation of the designated system is complete and in full operation.

2. Outside temperature conditions, occupant loads, lighting loads, special equipment requiring extra sensible or ventilation requirements, and solar conditions are within a reasonable range relative to design conditions.

PART 2 - PRODUCTS

2.01 INSTRUMENTS

A. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations and requirements of AABC.

B. Calibration histories for each instrument shall be available for examination.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect preceding work in accordance with Section 23 0010 BASIC MECHANICAL REQUIREMENTS.

3.02 PREPARATION

A. Air Systems: Check:

1. Filters are clean.

2. Filter leakage.

3. Damper operation and leakage.

4. Duct leakage.

5. Fan rotation.

6. Equipment vibration.

3.03 ADJUSTING AND BALANCING

A. General: Check, adjust and balance air and water system to meet the design performance and tabulate results on acceptable forms. Minimum data to include amperage, voltage input, and thermal heater capacity of each motor, equipment nameplate data and operating speed, pressure drop across each filter bank, pressure rise across each fan and pump, CFM capacity each outlet, zone and fan, and heating or cooling capacity of each coil or element.

B. Belt Drives: Adjust so that when the desired speed and belt tension had been established, the variable speed pulley and the belt tension adjustment shall be at approximately the midpoint of their range.

C. Air Systems:

1. Adjust dampers, diffusers, registers, and sheaves for the delivery and distribution of air quantities indicated on the drawings.

2. Mark balancing device at final setting.

3. Replacement of adjustable pulleys, installation of additional balancing dampers or pressure taps, required to effect proper air balance shall be furnished and installed by the HVAC Contractor at no additional cost to the Owner.

4. Adjust exhaust and recirculation air systems for air quantities indicated on drawings and to establish the proper relationship between supply and exhaust.

5. Adjust distribution system to obtain uniform space temperature free from objectionable drafts and noise within the capabilities of the system.

6. Acceptable Tolerances: Adjust fan systems, air devices, etc. as follows:

a. Supply air fan CFM: -5% to +5% of scheduled

b. Return air fan CFM: -5% to +5% of scheduled

c. Exhaust air fan CFM: -0% to +10% of scheduled

d. Supply air device CFM: -10% to +10% of scheduled

e. Return air device CFM: -10% to +10% of scheduled

f. Exhaust air device CFM: -0% to +10% of scheduled

g. Outside air CFM: -0% to +10% of scheduled

D. Test Run: In order to determine that the system installation is complete and will operate satisfactorily, make a test run with equipment operating per normal temperature control schedule and sequence. Run test and operate and adjust equipment as may be required during test run.

3.04 COMPLETION SERVICES

A. Final Check: Make final checks and do any rebalancing as directed.

B. Report: Submit Balancing Report as specified above.

C. Acceptance: Final acceptance of the project will not be made until a satisfactory report is received. Owner reserves the right to spot check the report by field verification prior to final acceptance.

END OF SECTION 23 0593

SECTION 23 0713

HVAC DUCT INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of mechanical insulation required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Ductwork System Insulation:

a. Fiberglass.

b. UL-Listed Grease Duct Enclosure Insulation System.

C. Refer to Section 23 3113 - METAL DUCTWORK for duct linings; not work of this section.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Manson.
2. Knauf Fiber Glass.
3. Johns Manville Products Corp.
4. Owens-Corning Fiberglass Corp.
5. UNIFRAX.
6. 3M

2.02 DUCTWORK INSULATION MATERIALS

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1.

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-4.

C. Listed Grease Duct Enclosure System: Specifically manufactured duct wrap insulation for grease duct systems, consisting of non-asbestos special fire protection grade ceramic or specially glass blanket. Insulation to comply with ASTM E-119 for one and two-hour rated fire resistive enclosures; ASTM E-136 for non-combustibility. The insulation system shall have been tested and listed by a National Testing Agency. Insulation to have foil-faced jacket on one or two sides. Allowable Products and Manufacturers:

1.	Fire Temp Wrap	Johns Manville
2.	FyreWrap EZ 1.5	UNIFRAX
3.	Fire Barriers Duct Wrap 615+	3M

D. Jackets for Ductwork Insulation: ASTM C 921, Type I (vapor barrier) for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.

E. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

F. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Thickness of insulation shall be as recommended by the manufacturer for the temperatures and pipe sizes involved, and in accordance with standards of T.I.M.A.

3.02 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted: Do not insulate fibrous glass ductwork or lined ductwork.

B. Grease Hood/Range Hood Exhaust Ductwork (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot ductwork:

a. Grease Hood/Range Hood exhaust ductwork.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. UL-Listed Grease Duct Enclosures System: 2 in. thick minimum. Thickness to be as required by specific manufacturer as required to achieve a 2 hour rating. Multiple layers of insulation may be used to reach the required rating, if this is a standard and listed application for the specific manufacturer's products.

C. Dual Temperature Ductwork:

1. Application Requirements: Insulate the following dual temperature ductwork:

a. Hot/cold supply and return ductwork between fan discharge or HVAC unit discharge and room terminal outlets; except omit insulation on return air ductwork located in return air ceiling plenums.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. Flexible Fiberglass: 2.2 in. thick, application limited to concealed locations. Flexible insulation will not be used in machine, fan and equipment rooms. Minimum R-value=6.0.

3.03 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.

G. Corner Angles: Except for oven and hood exhaust duct insulation; install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.04 PROTECTION AND REPLACEMENT

A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 0713

SECTION 23 3113

METAL DUCTWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. All duct dimensions shown on drawings are net inside clear dimensions.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible", First Edition, 2005, for fabrication and installation of metal ductwork.

2. ASHRAE Standards: Comply with ASHRAE Handbook latest edition, HVAC Systems and Equipment volume, Chapter 16 "Duct Construction", for fabrication and installation of metal ductwork.

3. NFPA Compliance: Comply with latest editions of NFPA 90A "Installation of Air Conditioning and Ventilating Systems" and NFPA 90B" Installation of Warm Air Heating and Air Conditioning Systems".

D. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

E. Flame/Smoke Ratings: Provide composite mechanical system (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

B. Shop Drawings: Submit scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and

proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 01.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 01.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop fabricated and factory fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials that are free from visual imperfections including pitting, seam marks, roller marks, and stains and discolorations, and other imperfections, including those that would impair painting.

B. Sheet Metal: All interior ducts shall be constructed with G-60 or better galvanized steel (ASTM A 653/A 653M) LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions (i.e. moisture laden exhausts not specified to be stainless steel) shall be G-90 or better galvanized steel LFQ, chem treat.

C. Stainless Steel Sheet: Lab exhaust ductwork shall be stainless steel complying with ASTM A167; Type 302, 304, or 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

2.02 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° laterals and 45° elbows for branch takeoff connections. Where 90° branches are indicated, provide conical type tees.

C. Duct Liner:

1. Fibrous glass, complying with Thermal Insulation Manufacturer's Association (TIMA) AHC-101; of thickness indicated with a minimum installed R-Value equal to 6.0 (1-1/2 in. thick minimum), with black-coated, fire-resistant airstream face, with EPA-registered antimicrobial agent.

2. Manufacturers:

    a. Certainteed "Toughgard".

    b. Knauf Type "EM".

    c. Johns Mansville "Permacote Linacoustic".

    d. Owens-Corning "Aeroflex Plus".

    e. No Substitutions

D. Duct Liner Adhesive:

1. Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation." Application shall conform to Manufacturer's written recommendations for the apparent application.

2. Adhesives shall be non-inflammable after curing.

3. Manufacturers:

    a. Benjamin-Foster.

    b. Duro Dyne "FPG".

    c. Kinco 15-137.

    d. Miracle PF-91.

    e. Manufacturer of duct liner used for this project.

E. Duct Liner Fasteners:

1. Comply with SMACNA "Installation Standards for Rectangular Ducts using Flexible Liner", Articles S2.0 through S2.11.

2. Comply with lining details as shown in the referenced SMACNA Section, Figures 2-22 and 2-23.

3. Clinched-pin type fasteners shall be "Grip-Nail", or approved equal.

4. Projecting pins in Type 3 or Type 4 applications shall be clipped off close enough to the retaining disc to provide proper anchoring and to prevent injury to personnel.

F. Duct Sealant:

1. Duct sealer shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall seal out water, air, and moisture. Sealer shall be UL listed and conform to ASTM E 84.

2. Comply with requirements of SMACNA Table 1-2.

3. Manufacturers:

   a. Benjamin-Foster

   b. Ductmate - PROseal.

   c. Duro Dyne S2.

   d. Hardcast.

   e. United Sheet Metal.

G. Duct Cement:

1. Non-hardening, non-migrating mastic or liquid elastic sealant of type applicable for fabrication/installation detail as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

2. Comply with requirements of SMACNA Table 1-2.

3. Manufacturers:

   a. Benjamin-Foster.

   b. Duro Dyne S2.

   c. Hardcast.

   d. United Sheet Metal.

H. Ductwork Support Materials:

1. General:

   a. Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

   b. Comply with applicable provisions of SMACNA 2005 Standards, Figures 4-1 through 4-8, and Tables 4-1 through 4-3.

2.03 FLEXIBLE DUCTS

A. General:

1. Spiral wound spring steel with flameproof metallized polyester sheathing, complying with UL181.

2. Comply with applicable provisions of SMACNA 2005 Standards, pages 3-13 through 3-20.

3. Installation shall conform to conditions under which UL listing was granted.

4. Flexible Ductwork runouts shall be limited to 6' - 0" extended length.

B. Insulation:

1. Insulate all flexible ducts, both supply and return, with a minimum R-Value of 6.0, per International Energy Conservation Code – latest edition. Duct shall have a continuous flexible fiberglass sheath with UL approved metallized polyester barrier jacket.

C. Flexible Ductwork shall be equal to ATCO #036.

D. Manufacturers: Subject to compliance with requirements, provide flexible ducts manufactured by one of the following:

1. ATCO.

2. Thermaflex.

3. Quietflex.

2.04 FABRICATION

A. Shop-fabricate ductwork in 4,8,10, or 12 ft. lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match mark sections for reassembly and coordinated installation.

B. All duct dimensions shown on drawings are net inside clear dimensions.

C. Shop-fabricate ductwork of gauges and reinforcement complying with SMACNA 2005 Standards as follows:

1. Rectangular, Steel:

a. Tables 1-1 through 1-13.

b. Figures 1-2 through 1-18.

c. Fittings and Construction, Section II.

2. Round, Oval and Flexible Duct: Section III.

D. Shop fabricate ductwork of gauges and reinforcement complying with ASHRAE Handbook, HVAC Systems and Equipment Volume, Chapter 16 “Duct Construction”.

E. Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

F. Ductmate or W.D.C.I. proprietary duct connection systems will be acceptable. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

G. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) will only be acceptable when submitted for approval prior to installation of any ductwork. Formed on flanges will be constructed as SMACNA T-25 flanges, whose limits are defined on Page 1.36 of the 2005 SMACNA Manual, First Edition. No other construction pertaining to form on flanges will be acceptable. Formed on flanges shall be acceptable for use on ductwork 42 in. wide or less, with 2 in. positive pressure static or less, and must include the use of corners, bolts and cleat.

H. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.

I. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 23 Section “Ductwork Accessories” for accessory requirements.

J. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Comply with previous paragraph 2.2.

K. Round Duct Joints:

1. 0 in. - 20 in. diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3 in. wide duct tape.

2. 21 in. - 72 in. diameter, use 3 piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.

L. Pressure Classifications:

1. Static pressure ratings for ductwork systems shall be as noted on the drawings, and/or shall conform to requirements of 2005 SMACNA Standards, Table 1-1.

2. In no case shall the pressure rating of the duct be less than that indicated in Table 1-1 for the apparent duct velocity.

3. Gauges of metal and reinforcing methods shall conform to SMACNA requirements as follows:

   a. Rectangular Steel: Table 1-3 through 1-13.

   b. Rectangular Aluminum: Tables 1-14 through 1-16.

   c. Round, or Flat Oval, Steel: Table 3-2.

2.05 FACTORY-FABRICATED DUCTWORK

A. At Contractor's option, factory-fabricated ductwork sections, fittings, etc., may be substituted for shop-made items.

B. Factory-fabricated items shall comply in every respect with SMACNA requirements listed previously in this Section, or show proof from a recognized, approved independent laboratory, prior to bidding, that the proposed construction methods produce products that equal, or exceed, the SMACNA 2005 Standards.

C. Comply with applicable provisions of International Mechanical Code and local ammendments.

D. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork and/or fittings of one of the following:

1. Ductmate, Inc., Monongahela, PA.

2. Semco Mfg., Inc.

3. United Sheet Metal Div., United McGill, Inc.

2.06 KITCHEN EXHAUST DUCTS

A. Kitchen Hood: Fabricate kitchen exhaust ducts and supports, used for smoke and vapor removal from cooking equipment, of 16 ga minimum carbon steel with black iron coating with continuous liquid tight external welds at all seams and joints where concealed, and of 18 ga minimum stainless steel where exposed. Kitchen exhaust ducts shall not be galvanized. For duct construction, comply with SMACNA "HVAC Duct Construction Standards", and NFPA 96 "Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment".

1. Provide duct access doors at all changes in direction and at 20 ft. o.c. (or more often if required by code) in all grease exhaust ducts.

PART 3 - EXECUTION

3.01 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3 in. and under; 1% for systems rated over 3 in.) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8 in. misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type that will hold ducts true to shape and to prevent buckling. Support vertical ducts at every floor. Seal all longitudinal and transverse duct joints and seams with non-hardening duct mastic.

B. All round duct taps shall be conical type. All rectangular duct taps shall have 45° mitered entry per SMACNA.

C. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

D. Field Fabrication: Complete fabrication of work at project as necessary to match shop fabricated work and accommodates installation requirements.

E. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Where possible, locate insulated ductwork for 1 in. clearance outside of insulation. Limit clearance to 1/2 in. where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with structural members, suspended ceiling, lighting layouts, sprinkler piping, plumbing systems and similar finished work.

F. Electrical Equipment Spaces: Do not route ductwork through Electric Rooms, transformer vaults, and other electrical equipment spaces and enclosures.

G. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 in. Fasten to duct and substrate.

1. Where ducts pass through fire rated floors, walls, or partitions, provide fire stopping between duct and substrate, in accordance with requirements of Division 07 Section "FIRE STOPPING".

H. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

3.03 INSTALLATION OF DUCT LINER

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards, pages 2-25 thru 2-29.

B. All supply and return ductwork serving air handlers shall be lined with 1-1/2 in. thick acoustical within the mechanical room.

3.04 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6 ft. 0 in. extended length.

B. Installation: Install in accordance with Section III of SMACNA's, HVAC Duct Construction Standards, Metal and Flexible".

3.05 INSTALLATION OF KITCHEN EXHAUST DUCTS

A. Kitchen Hood: Fabricate joints and seams with continuous welds for watertight construction. Provide for thermal expansion of ductwork through 2000°F (1093°C) temperature range. Install without dips or traps that may collect residues, except where traps have continuous or automatic residue removal. Provide duct access doors at all changes, located on sides of duct 1-1/2 in. minimum from bottom, in direction and at 20 ft. o.c.)or more often if required by code) in all grease exhaust ducts. Access doors shall be fitted with grease tight covers of same material as duct.

3.06 FIELD QUALITY CONTROL

A. Leakage Tests: After installation of each duct system that is constructed for duct classes over 3 in. is completed, test for duct leakage. Repair leaks and repeat tests until total leakage is less than 1% of system design airflow.

B. The testing shall be performed as follows:

1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.

2. Use a certified orifice tube for measuring the leakage.

3. Define section of system to be tested and blank off.

4. Determine the percentage of the system being tested.

5. Using that percentage, determine the allowable leakage (CFM) for that section being tested.

6. Pressurize to operating pressure and repair any significant or audible leaks.

7. Re-pressurize and measure leakage.

8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

3.07 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

C. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until time connections are to be completed.

D. Balancing: Refer to Division 23 Section “TESTING, ADJUSTING AND BALANCING” for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 23 3113

SECTION 23 3113.19

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork accessories required for project include the following:

1. Dampers.

a. Low-pressure manual dampers.

b. Control dampers.

2. Fire dampers.

3. Turning vanes.

4. Duct hardware.

5. Duct access doors.

6. Flexible connections.

7. Concealed Damper Regulators.

C. Refer to other Division 23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA “HVAC Duct Construction Standards, Metal and Flexible,” 2005 edition.

2. Industry Standards: Comply with latest ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 “Fire Dampers and Ceiling Dampers.”

4. NFPA Compliance: Comply with applicable provisions of NFPA 90A latest edition "Installation of Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly type Shop Drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and Shop Drawings in maintenance manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.01 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multi blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards."

B. Control Dampers: Provide dampers with parallel blades for 2-position control, or opposed blades for modulating control. Construct blades of 16-ga steel; provide heavy-duty molded self-lubricating nylon bearings, 1/2 in. diameter steel axles spaced on 9 in. centers. Construct frame of 2 in. x 1/2 in. x 1/8 in. steel channel for face areas 25 sq.ft. and under; 4 in. x 1-1/4 in. x 16-ga channel for face areas over 25 sq.ft. Provide galvanized steel finish with aluminum touch up.

C. Control Dampers: Refer to Division 23 Section "CONTROL SYSTEMS": for control dampers; not work of this section.

D. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

1. Air Balance, Inc.

2. Nailor

3. American Warming & Ventilating, Inc.

4. Louvers & Dampers, Inc.

5. Penn Ventilator Co.

6. Ruskin Mfg. Co.

7. Pottorff

E. Fire Damper (FD)

1. Fabricated Fire Dampers: Provide dampers constructed in accordance with SMACNA "Fire Damper and Heat Stop Guide".

2. Damper frames shall be constructed of minimum 16 gauge welded galvanized steel channel. Frames in excess of 36 in. height shall have corner braces or equivalent means of strengthening to ensure squareness and rigidity. Frames shall be constructed for flanged ductwork connection. "Slip In" (insertion) type dampers shall not be acceptable. Frames shall be sized to match the final dimensions of the ducts including allowance where applicable, for the duct lining materials. Coordinate required installation details with Mechanical Installer.

3. Fire Dampers: Provide Class B or C Fire dampers, of types and sizes indicated. Provide fusible link rated at 160 to 165°F (71 to 74°C) unless otherwise indicated or required for special exhaust systems. Provide damper with positive lock in closed position, and with the following additional features:

   a. Damper Blade Assembly: Multi blade type, completely out of airstream.

   b. Damper Blade Assembly: Curtain type, completely out of the airstream.

   c. Blade Material: Steel, match casing.

   d. Blade Material: Stainless Steel.

4. Measurements diagonally from upper to lower opposite corners of the installed damper assembly, including multiple section dampers shall not differ by more than 1/8 in. or 0.2%, whichever is the greater.

5. Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:

   a. Air Balance, Inc.

   b. American Warming & Ventilating, Inc.

   c. Greenheck

   d. Louvers and Dampers, Inc.

   e. Nailor

   f. National Control Air

   g. Penn Ventilator Co.

   h. Pottorff

2.02 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

B. Turning Vanes: Turning vanes shall be double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs that align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs when fastened per the manufacturer's instructions.

C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of air-foil shaped aluminum extrusions with perforated faces and fiberglass fill.

D. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:

1. Aero Dyne Co.
2. Anemostat Products Div.; Dynamics Corp. Of America
3. Barber-Colman Co.
4. Ductmate Industries, Inc.
5. Duro Dyne Corp.
6. Hart & Cooley Mfg. Co.
7. Register & Grille Mfg. Co., Inc.

2.03 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 in. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

2.04 DUCT ACCESS DOORS

A. General: Provide where indicated, duct access doors of size indicated.

B. Construction: Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12 in. high and smaller, 2 handle-type latches for larger doors.

C. As an option, clamping type access doors may be installed.

D. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:

1. Air Balance Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Corp.
4. Register & Grille Mfg. Co., Inc.
5. Ruskin Mfg. Co.
6. Ventfabrics, Inc.
7. Zurn Industries, Inc; Air Systems Div.

2.05 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections wherever ductwork connects to vibrating equipment. Construct flexible connections of neoprene coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

1. American/Elgen Co,; Energy Div.
2. Ductmate Industries
3. Duro Dyne Corp.
4. Flexaust (The) Co.
5. Ventfabrics, Inc.

2.06 CONCEALED DAMPER REGULATORS: FOR VOLUME DAMPERS LOCATED ABOVE GYP BOARD, PLASTER OR OTHER HARD CEILINGS:

A. Concealed damper regulators shall be designed to control volume dampers from the ceiling line. Regulators shall be imbedded so the entire unit is flush with the finished surface. The regulator cover plate shall cover the joint between the box and the ceiling. The cover shall be adjustable from 1/2 in. to 1-1/8 in. utilizing the manufacturer's spanner wrench. Coverplate to have zinc plated finish, suitable for painting. Concealed damper regulators to be Young Regulator Model 315.

B. Volume dampers for concealed damper regulators shall be Young Regulator Model 5020-B (round) or Model 820A-C (rectangular), designed and installed for operation by ceiling mounted regulators.

C. Where required, provide Young Regulator Model 927 Right Angle Miter Gears, or Model 1200 Right Angle Worm Gear Regulator, to allow control of a damper that has the damper shaft perpendicular to the shaft from the ceiling mounted damper regulator.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90° elbows in supply, return and exhaust air systems, and elsewhere as indicated.

C. Install manual balancing dampers for branch ducts and individual runout ducts as close to the main duct as possible.

D. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

E. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

1. Label access doors in accordance with Division 23 Section “MECHANICAL IDENTIFICATION”.

2. Final positioning of manual dampers is specified in Division 23 Section “MECHANICAL TESTING, ADJUSTING AND BALANCING”.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer’s touch-up paint.

3.05 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 23 3113.19

SECTION 23 3400

FANS

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of fan work required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Types of centrifugal fans required for project include the following:

1. Ceiling Mounted Fans.

C. Refer to Section 23 0512 - "MECHANICAL AND ELECTRICAL COORDINATION" for responsibility of electrical work. Electrical work required of Division 23 shall be done in compliance with requirements of Division 26 sections.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of centrifugal fans, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years.

B. Codes and Standards:

1. AMCA Compliance: Provide centrifugal fans bearing the AMCA Certified Ratings Seal. Sound rate centrifugal fans in accordance with AMCA 300 "Test Code for Sound Rating Air Moving Devices".

2. ASHRAE Compliance: Test and rate centrifugal fans in accordance with ASHRAE 51 (AMCA 210) "Laboratory Methods of Testing Fans for Rating", latest edition.

3. UL Compliance: Provide centrifugal fan electrical components that have been listed and labeled by UL.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for fans, including specifications, capacity ratings, fan performance curves with operating point clearly indicated, gauges and finishes of materials, dimensions, weights, accessories furnished, and installation instructions.

B. Shop Drawings: Submit assembly-type shop Drawings showing fan dimensions, required clearances, construction details, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to fan units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data, product data; shop Drawings, and wiring diagrams in maintenance manuals; in accordance with requirements of Division 01.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install-damaged components; replace and return damaged components to centrifugal fan manufacturer.

C. Store fans in clean dry place and protect from weather and construction traffic.

D. Comply with manufacturer's rigging and installation instructions for unloading fans, and moving them to final location.

PART 2 - PRODUCTS

2.01 CEILING MOUNTED FANS

A. Centrifugal Ceiling Exhausters: Provide centrifugal ceiling exhausters, designed for ceiling or wall mounting, of type, size and capacity as scheduled.

B. Provide AMCA Certified Ratings Seal.

C. Provide ceiling mounted fans with round damper and duct connector, UL listing and brackets for mounting.

D. Type: Provide galvanized steel housing lined with acoustical insulation, adaptable for ceiling or wall installation. Provide centrifugal fan wheels mounted on motor shaft with fan shrouds, all removable for service. Provide integral back draft damper fan discharge.

E. Grille: Provide plastic louvered grille with flange on intake with thumbscrew attachment to fan housing.

F. Motor: Provide permanent split capacitor motor, permanently lubricated, with grounded cord and plug.

G. Electrical: Provide junction box for electrical connection on housing, and receptacle for motor plug in. Furnish remote fan speed control, solid state, capable of controlling fan speed from full speed to approximately half speed. Interlock fan as indicated on drawings or schedules.

H. Accessories: Provide transition fittings and manufacturer's standard roof jack or wall grille/louver as indicated on drawings or schedules.

I. Manufacturer: Subject to compliance with requirements, provide centrifugal ceiling exhausters of one of the following:

1. Greenheck
2. Loren Cook Co.
3. Broan

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which fans are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF FANS

A. General: Install fans where indicated, in accordance with manufacturer's installation instructions, and with recognized industry practices, to ensure that fans comply with requirements and serve intended purposes.

B. Access: Provide access and service space around and over fans as required, but in no case less than that recommended by manufacturer.

C. Isolation: Isolate fans with vibration isolators; fasten in accordance with manufacturer's installation instructions.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Ensure that rotation is in direction intended for proper performance. Do not proceed with fan start-up until wiring installation is acceptable to centrifugal fan Installer.

E. Ductwork Connections: Refer to Division 23 "METAL DUCTWORK" sections. Provide flexible connections on inlet and outlet duct connections.

3.03 FIELD QUALITY CONTROL

A. Upon completion of installation of fans, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected.

3.04 ADJUSTING AND CLEANING

A. Start-up, test, and adjust fans in presence of manufacturer's authorized representative.

END OF SECTION 23 3400

SECTION 23 3713

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of air outlets and inlets work is indicated by Drawings and schedules, and by requirements of this section.

B. Types of air outlets and inlets required for project include the following:

1. Ceiling return air grilles.

2. Ceiling air diffusers.

3. Wall registers and grilles.

4. Linear slot diffusers

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets", latest edition.

3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".

4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of aluminum, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling systems that will contain each type of ceiling air diffuser. All air devices installed in plaster, gyp board or other hard ceilings or walls shall be provided with a separate mounting frame.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on the air device schedule.

E. Diffuser Finishes:

1. Finish shall be off-white baked enamel.

2. Color selection shall be from manufacturer's standard color chips, unless otherwise noted.

F. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

1. Metalaire,
2. Krueger,
3. Nailor,
4. Price,
5. Titus,
6. No Substitutions.

2.02 WALL REGISTERS AND GRILLES

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of wall construction that will contain each type of wall register and grille.

D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes as listed on the air device schedule.

E. Register and Grille Finishes:

1. Finish shall be off-white baked enamel.
2. Color selection shall be from manufacturer's standard color chips, unless otherwise noted.

F. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

1. Metalaire,
2. Krueger,
3. Nailor,
4. Price,

5. Titus,

6. No Substitutions.

2.03 CEILING GRILLE

A. General: Except as otherwise indicated, provide manufacturer's standard grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide grilles that have, as minimum, noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling construction with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling construction that will contain each type of ceiling grille.

D. Types: Provide ceiling grilles of type and with accessories as listed on the air device schedule.

E. Grille Finishes:

1. Finish shall be off-white baked enamel.

2. Color selection shall be from manufacturer's standard color chips, unless otherwise noted.

F. Manufacturer: Subject to compliance with requirements, provide grilles of one of the following:

1. Metalaire,

2. Krueger,

3. Nailor,

4. Price,

5. Titus,

6. No Substitutions.

2.04 LINEAR SLOT DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer’s standard diffusers where shown; of size, shape, capacity and type indicated; constructed materials and components as indicated, and as required for complete installation. Slot diffusers shall be constructed of aluminum with bi-directional, adjustable control vanes that shall be capable of deflecting the air pattern from horizontal along the ceiling, to straight down, or at an intermediate setting. Unit shall be so designed that when deflecting vanes are in the closed position, the air pressure tends to form a tight seal. Airflow rate can be varied without changing the air pattern. The set

of vanes in the diffuser that controls the air pattern and flow rate shall perform these functions satisfactorily without the use of an additional damper. Each length of diffuser shall be capable of being installed without any visible means of fastening. Each length of diffuser shall have a self-aligning device permitting long lengths to be aligned without the aligning device visibly apparent.

B. Performance; Provide diffusers that have, as minimum, noise criteria ratings, pressure drop, and throw for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility; provide diffusers with borders styles that are compatible with adjacent ceiling systems or for suspended mounting, and that are specifically manufactured to fit into ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling construction that will contain each type of slot diffuser.

D. Types: Provide slot diffusers of type and with accessories as listed on grille schedule.

1. Grille Finishes:

a. Finish shall be white baked enamel, or primer as scheduled.

2. Boot Plenums:

a. Provide all slot diffusers with lined boot plenums with neck size equal to that shown in drawings on the run outs.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include; but are not limited to, the following:

1. Metalaire,

2. Krueger,

3. Nailor,

4. Price,

5. Titus,

6. No Substitutions.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

3.03 SPARE PARTS

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 23 3713

SECTION 23 8126

SPLIT DX COOLING/HEATING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes split DX cooling/gas heating systems.

B. Related Sections:

1. Section 23 0512 - MECHANICAL AND ELECTRICAL COORDINATION.

2. Section 22 1000 - PLUMBING PIPING.

3. Section 22 1001 - PLUMBING SPECIALTIES.

4. Section 23 3113 - METAL DUCTWORK.

5. Section 23 0593 - MECHANICAL TESTING, ADJUSTING AND BALANCING.

1.02 SUBMITTALS

A. General: Do not use submittals as a proposal for equipment that has not been pre-approved during the bid process.

1. Do not base bids on unapproved items!

B. Product Data: Submit manufacturer's technical product data, indicating full compliance with scheduled capacities and characteristics, including specific capacities at the scheduled entering air conditions, dimensions, weights, operating clearances and specific references to all specialties and accessories as scheduled or specified, including installation and start-up instructions.

1. Data that does not apply to this specific project shall be marked out, or suitably deleted.

2. Units shall be specifically identified, using the same nomenclature as shown on the plans.

C. Shop Drawings: Submit shop Drawings detailing the following:

1. Electrical requirements for power supply.

2. Ladder-type wiring diagrams for interlock and control wiring. Wiring diagrams shall clearly delineate field and factory wiring requirements, as well as the incorporation of special features that only apply to this specific project.

3. Provide a submittal from Honeywell Controls for the proposed HVAC building controls system (BCS) for review and approval by the design team and owner.

D. Operation and Maintenance Data: Include maintenance data and parts lists for each unit, including "trouble- shooting" and maintenance guide, servicing guide and preventative maintenance schedule and procedures in the Maintenance Manual required in accordance with requirements of Division 01.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of heating and cooling units, of the types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Testing and Rating Standards: Comply with applicable provisions of the following standards in effect as of the date of the Contract documents:

a. UL Compliance: Units shall be UL-listed, and the unit shall bear the UL seal. Units shall be designed, manufactured and tested in accordance with UL requirements.

b. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards.

c. NEC Compliance: Comply with National Electrical Code (NFPA 70) latest edition as applicable to installation and electrical connections of ancillary electrical components of air handling units.

d. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards 210 and 500.

e. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A “Installation of Air Conditioning and Ventilating Systems”, latest edition.

f. ARI Compliance: Test and rate air handling units in accordance with ARI 430 “Standard for Central Station Air Handling Units”, display certification symbol on units of certified models.

g. ARI Compliance: ARI 210 “Standard for Unitary Air Conditioning Equipment.”

h. ARI Compliance: ARI 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment."

i. ARI Compliance: ARI 270 "Standard for Sound Rating of Outdoor Unitary Equipment."

j. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 “Safety Code for Mechanical Refrigeration”, latest edition.

k. ASHRAE Compliance: Energy Efficiency Ratio (EER) of condensing units shall be not less than that indicated in ASHRAE Standard 90.1 "Energy Conservation in New Building Design", latest edition.

l. Equipment shall bear the appropriate Certified Rating Seal.

1.04 DELIVERY, STORAGE AND HANDLING

A. Handle units and components carefully to prevent damage. Replace damaged units or components with new.

B. Store units and components in a clean, dry place, off the ground, and protect from weather, water, and physical damage.

1.05 SCHEDULING AND SEQUENCING

A. Coordinate roof opening locations and mechanical, electrical, gas and drain locations.

1.06 SPECIAL WARRANTY

A. Warranty on Compressor and Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors and heat exchanger which show inadequate and defective materials and/or workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting and maintaining units have been properly followed during the warranty period. Replacement is limited to component replacement only, and does not include labor for removal and re-installation.

B. Warranty Card shall plainly state the name of the project, the starting and ending dates of the warranty period, and the serial numbers of the included equipment.

1.07 MAINTENANCE

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each unit:

1. One set of matched fan belts for each belt-driven fan.

2. One set of replacement filter media.

PART 2 - PRODUCTS

2.01 AIR HANDLERS/DX COIL

A. General - Furnish and install a blower-coil-filter unit. The unit shall be a standard product of a firm regularly engaged in the manufacture of heating-cooling equipment. The manufacturer shall have parts and service available throughout the United States.

B. The equipment shall be shipped assembled ready for necessary field connections. Blower motor and pulley shall be shipped separate and field installed. Units shall have horizontal air distribution as indicated or required.

C. DX Cooling System - The total certified cooling capacity shall not be less than scheduled Btuh with an evaporator air volume as scheduled.

D. The coil shall be non-ferrous construction with aluminum fins machine fitted to copper tubes. Coil shall be factory pressure leak tested.

E. Air Movers - Centrifugal conditioned air blowers shall have statically and dynamically balanced, forwardly curved, double inlet blower wheels, permanently lubricated bearings, adjustable belt drives with capacities as scheduled.

F. Cabinet - The unit cabinet shall be constructed of galvanized steel with a baked-on enamel finish. Panels shall be insulated with not less than one-inch thick fiberglass insulation. Cabinet shall be equipped with large removable panels providing service access to interior. Inlets shall be provided for refrigerant line and power connection entry. Dual Connections shall be accessible external to the cabinet.

G. Air Filters - Manufacturer's standard throwaway filters shall be furnished. Filter rack shall be integral to the unit casing and shall be capable of holding optional cleanable filters.

H. Provide each unit with a heavy steel plenum box/filter housing with 1 in. thick lined insulation and adjustable filter rack equal to McDaniel's Metals, Inc. (Houston, Texas) Labor Saver Filter Housing Series LS.

I. Vibration Isolation - provide vibration control treatment for furnace (springs, pads, etc.) as recommended by ASHRAE for this application.

J. Air Handler/DX coil shall be of the following manufactures:

1. Carrier.

2. No Substitutions.

2.02 HEAT PUMP

A. General - Furnish and install an outdoor heat pump unit. The unit shall be shipped completely factory assembled, piped and wired internally ready for field connections. In addition, manufacturer shall test operate unit at the factory before shipment. The condensing unit shall be a standard product of a firm regularly engaged in the manufacturer of heating-cooling equipment. The manufacturer shall have parts and service available throughout the United States.

B. Unit Capacity - The total cooling capacity and total heating capacity shall be as scheduled.

C. Compressor - Units shall be variable speed compressors providing staging control to deliver varying cooling load requirements. Compressor shall be resiliently mounted; suction cooled,

overloaded protected, internal pressure relief protected and has internal excessive current and temperature protection. Shall have vertical crankshaft, ringed valves and piston, turned discharge muffler, efficient oil pump and crankcase heater.

D. Refrigerant System - Shall include liquid line service valve, suction line service valve, gauge ports, hi-capacity drier, thermometer well, high and low pressure switches and timed-off control.

E. Condenser Coil(s) - Coil(s) shall be non-ferrous construction with aluminum fins mechanically bonded to durable copper tubes. Coil(s) shall be pressure leak tested. Coil(s) shall be protected with expanded metal type hail guards(s).

F. Casing - Shall be constructed of galvanized steel that has been through a metal wash preparation and have a finish coat of baked-on outdoor enamel. Large access panel shall be provided to allow complete service. The base section shall be provided with moisture-removed openings. Openings shall be provided for refrigerant lines and power connection entry.

G. Air Mover - Shall be direct blade type fan(s). Motor(s) shall have inherent protection devices and shall be protected from moisture. Fan(s) shall be protected with steel guards(s).

H. All wiring shall be in compliance with NEC. Shall be rated in accordance with ARI Standard 210-81 vand 360-86. Units shall have U.L. listing. Units shall have ETL Testing Laboratories listing where applicable.

I. Warranty - The compressor shall have a warranty for five years. All other components shall have a warranty for one year.

J. Heat pump shall be of the following manufactures:

1. Carrier.

2. No Substitutions.

2.03 REFRIGERANT PIPING

A. Pipe material shall be Type "L" copper tubing, hard drawn with copper solder type fittings suitable for connection with silver solder. Soft drawn copper "pre-charged" refrigerant piping should be acceptable for split-system units where developed length between evaporator and condensing unit is within manufacturer guidelines.

B. All piping shall be installed parallel or perpendicular to the building construction. All piping shall be installed so as to allow for expansion.

C. When "pre-charged" piping is not used, all piping joints shall be made with silver solder. The piping shall be charged with dry nitrogen while constructing the joints. A removable type drier strainer shall be installed in the liquid line. After the Freon piping has been completed, the refrigerant system shall be pressured tested at a pressure of 300 psi (high side) and 150 psi (low side. While the system is being pressure tested, an electronic leak detector shall be used to check for leaks. Pressure shall be maintained on the system for a minimum of 12 hours. The system shall be evacuated when the surrounding ambient air is not less than 60°F. A minimum

vacuum of 2.0mm of mercury shall be pulled on the system and maintained for 12 hours. The vacuum pressure displacement shall be not less than 5 CFM. The vacuum shall be checked with an electronic gauge.

D. All pipes shall be supported from the building structure in a neat and workmanlike manner, and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze type hangers. The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted. Spacing of pipe supports shall not exceed 6 ft. for pipes up to 1-1/4 in. and 10 feet on all other piping. Hangers shall pass around the insulation and an 18 guage steel protective band, 12 in. long, shall be inserted between the hangers and the insulation.

E. Insulation material shall be 1/2 in. thick for all pipe sizes up to 1 in. and 1 in. thick for all pipe sizes over 1 in. Insulation shall be flexible closed cell foam equal to ArmaFlex by Armacell, or approved equal. All refrigerant suction piping shall be insulated. Pipe insulation shall have a flame spread rating of not over 25, 50 smoke developed and 50 fuel contributed. Verify insulation requirements with code when installed in return air plenum spaces.

F. All pipe insulation shall be applied over clean, dry surfaces, butting adjoining sections firmly together. All fittings shall be installed and finished in strict accordance with manufacturer's recommendations. Insulation exposed to weather shall have waterproof and UV resistant covering equal to ArmaFlex Shield by Armacell.

2.04 ELECTRIC TEMPERATURE CONTROLS

A. The City of West University Place has an existing Honeywell control system. HVAC controls for this project shall be compatible and connected to the city's front end. Furnish and install all sensors, wiring, interlocks, network connections, etc. as required for a complete and operable system.

B. Room thermostats/temperature sensors shall be user adjustable with a LCD readout. Confirm and comply with all city standards.

C. Electrical Standards: Provide electrical products that have been tested, listed and labeled by Underwriter's Laboratories and comply with NEMA standards.

D. Provide the required electric temperature control products in the sizes and capacities indicated, complying with the manufacturer's published product information on standard materials and components designed and constructed as recommended by the manufacturer for the applications indicated.

E. Provide automatic outside air dampers as shown on the Drawings. Dampers shall be complete factory assembled motorized damper constructed of anodized extruded aluminum with stainless steel gearing and linkage. Dampers shall be as manufactured by Trol-A-Temp or approved equal.

F. Install control system and materials in accordance with manufacturer's instructions and roughing-in drawings. Install electrical work and use electrical products complying with the

requirements of the applicable Division 26 sections of these specifications. Mount controllers at convenient locations and heights.

G. After completion of the installation, adjust and program sensors/thermostats, and similar equipment provided as work of this section.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General: Install units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Electrical Connections: Coordinate with Electrical for final connections to equipment and installation of loose-shipped electrical components.

3.03 DEMONSTRATION

A. Start-Up Services: Provide the services of a factory-authorized service representative to start-up units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Operating and Maintenance Training:

1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of units. Training shall consist of a minimum of 8 hours, not necessarily consecutive, and shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division 01.

2. Schedule training with Owner; provide at least 7-day prior notice.

3. Provide a written report of training periods to Owner and Architect.

3.04 PIPING CONNECTIONS

A. Refer to Section 22 1000 of these specifications for condensate drain piping.

END OF SECTION 23 8126

SECTION 23 8127

DUCTLESS SPLIT AIR CONDITIONING UNITS

PART 1 - GENERAL

1.01 GENERAL

A. All work shall be in accordance with the "General Conditions", "Supplemental Conditions" and the "General Requirements for Mechanical Work".

B. All work shall be in accordance with City Building, Plumbing and Mechanical Codes and with all state and national codes as they may apply to the project and to public safety.

1.02 SCOPE OF WORK

A. All have equipment shall be provided by the same manufacturer.

B. It is the intent that the contractor shall install a complete and operable air conditioning system, fully adjusted and ready for use.

C. Materials and equipment have been carefully selected for the project. The Contractor is expected to furnish and install items that the specification required as closely as possible.

D. The drawings accompanying these specifications show the extent of the HVAC work and the general arrangement. The drawings, however, are diagrammatic and exact layout of the systems is the responsibility of the Contractor.

E. The Contractor shall pay all fees and charges to City or other agencies.

1.03 HVAC SUBMITTAL

A. The Contractor shall check all items of submittal data and verify by statement and initial that each item has been checked for the following conditions:

1. Item is equal to specified item in construction and quality.

2. Item is of the same physical size. If not of the same physical size, the dimensions have been checked and item will fit within the allocated space shown on the drawings. Where items proposed are different than scheduled item, furnish 1/4 in. scale plan and 1/4 in. sections on tracing paper (for direct overlay) of proposed equipment including space required for connections or service. The tracing of 1/4 in. plans and 1/4 in. sections must be furnished in submittal for other than scheduled equipment in order to compare proposed equipment with scheduled equipment.

3. System connections to the item can be made as shown on the drawings.

4. Shop drawings show in detail all connections, etc., required to meet the overall specifications in every detail.

5. Statement of guarantee that the proposed equipment shall operate properly as applied to the project and will not require additional devices or changes in the installation shown on the drawings.

B. Complete specification data shall be submitted for all HVAC items, including the list below:

1. Ductless Split Air Conditioning Units

C. When equipment other than specified is proposed, the Contractor shall be responsible for the proper design and installation of electrical power to equipment. Submit listing of electrical feeder size, conduit size, breaker size, etc., for each item of equipment for review.

1.04 SHOP DRAWINGS

A. Provide a submittal from Honeywell Controls for the proposed HVAC building controls system (BCS) for review and approval by the design team and owner.

PART 2 - MATERIALS

2.01 DUCTLESS SPLIT AIR CONDITIONING UNITS

A. General - Furnish and install an indoor ductless fan coil unit and outdoor heat pump unit. The unit shall be shipped completely factory assembled, piped and wired internally ready for field connections. In addition, manufacturer shall test operate unit at the factory before shipment. The equipment shall be standard products of a firm regularly engaged in the manufacturer of heating-cooling equipment. The manufacturer shall have parts and service available throughout the United States.

B. Unit Capacity - The total cooling capacity and total heating capacity shall be as scheduled.

C. Compressor - Units shall be single speed compressors or two speed compressors providing staging control to deliver varying cooling load requirements. Compressor shall be resiliently mounted, suction cooled, overload protected, internal pressure relief protected and have internal excessive current and temperature protection. Units shall have vertical crankshaft, ringed valves and piston, tuned discharge muffler, efficient oil pump and crankcase heater.

D. Refrigerant System - Shall include liquid line service valve, suction line service valve, gauge ports, hi-capacity drier, thermometer well, high and low pressure switches and timed-off control.

E. Condenser Coil(s) - Coil(s) shall be non-ferrous construction with aluminum fins mechanically bonded to durable copper tubes. Coil(s) shall be pressure leak tested. Coil(s) shall be protected with expanded metal type hail guard(s).

F. Air Mover - Shall be direct blade type fan(s). Motor(s) shall have inherent protection devices and shall be protected from moisture. Fan(s) shall be protected with steel guard(s).

G. All wiring shall be in compliance with NEC. All wiring shall be rated in accordance with ARI Standard 210-81 and 360-86. Units shall have UL listing. Units shall have ETL Testing Laboratories listing where applicable.

H. Indoor wall mounted unit cabinet shall be of a durable ABS plastic with a galvanized steel sub-chassis. The filter shall be nylon mesh, easily accessible, washable and reusable. Unit shall have manually adjustable discharge fins. Unit shall be wall mounted with all pipe connections accessible from the cabinet. There shall be a removable end-cap for access to controls and for servicing.

I. Condensate drain pan shall be plastic or galvanized steel with an anti-corrosion coating.

J. A condensate pump shall be provided and installed for each indoor unit.

K. Warranty - The compressor shall have a warranty for five years. All other components shall have a warranty for one year.

L. Acceptable manufacturers:

1. Carrier.

2. No Substitutions.

2.02 REFRIGERANT PIPING

A. Pipe material shall be Type "L" copper tubing, hard drawn with copper solder type fittings suitable for connection with silver solder. Soft drawn copper "pre-charged" refrigerant piping should be acceptable for split-system units where developed length between evaporator and condensing unit is within manufacturer guidelines.

B. All piping shall be installed parallel or perpendicular to the building construction. All piping shall be installed so as to allow for expansion.

C. When "pre-charged" piping is not used, all piping joints shall be made with silver solder. The piping shall be charged with dry nitrogen while constructing the joints. A removable type drier strainer shall be installed in the liquid line. After the Freon piping has been completed, the refrigerant system shall be pressured tested at a pressure of 300 psi (high side) and 150 psi (low side. While the system is being pressure tested, an electronic leak detector shall be used to check for leaks. Pressure shall be maintained on the system for a minimum of 12 hours. The system shall be evacuated when the surrounding ambient air is not less than 60°F. A minimum vacuum of 2.0mm of mercury shall be pulled on the system and maintained for 12 hours. The vacuum pressure displacement shall be not less than 5 CFM. The vacuum shall be checked with an electronic gauge.

D. All pipes shall be supported from the building structure in a neat and workmanlike manner, and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze type hangers. The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted. Spacing of pipe supports shall not exceed 8 ft. for pipes up to 1-1/4 in. and 10 feet on all other piping. Hangers shall pass around the insulation

and an 18 guage steel protective band, 12 in. long, shall be inserted between the hangers and the insulation.

E. Insulation material shall be 1 in. thick for all pipe sizes up to and including 1-1/2 in., 1-1/2 in. thick for all pipe sizes over 1-1/2 in., foamed plastic, heavy density, J-M Aero tube, or approved equal. All refrigerant suction piping shall be insulated. Pipe insulation shall have a flame spread rating of not over 25, 50 smoke developed and 50 fuel contributed. Verify insulation requirements with code when installed in return air plenum spaces.

F. All pipe insulation shall be applied over clean, dry surfaces, butting adjoining sections firmly together. All fittings shall be installed and finished in strict accordance with manufacturer's recommendations. Insulation exposed to weather shall have waterproof and UV resistant covering.

2.03 CONTROLS

A. The City of West University Place has an existing Honeywell control system. HVAC controls for this project shall be compatible and connected to the city's front end. Furnish and install all sensors, wiring, interlocks, network connections, etc. as required for a complete and operable system.

B. Room thermostats/temperature sensors shall be user adjustable with a LCD readout. Confirm and comply with all city standards.

C. After completion of the installation, adjust and program sensors/thermostats, and similar equipment provided as work of this section.

PART 3 - INSTALLATION

3.01 EXAMINATION

A. Examine areas and conditions under which units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General: Install units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Electrical Connections: Coordinate with Electrical for final connections to equipment and installation of loose-shipped electrical components.

3.03 DEMONSTRATION

A. Start-Up Services: Provide the services of a factory-authorized service representative to start-up units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Operating and Maintenance Training:

1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of units. Training shall consist of a minimum of 8 hours, not necessarily consecutive, and shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division 01.

END OF SECTION 23 8127

SECTION 23 8965

MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SUMMARY

A. Manufacturer's Data: Submit manufacturer's data and installation instructions on motor controllers.

1.02 QUALITY ASSURANCE

A. Comply with applicable requirements of NEC as applicable to installation, and construction of motor controllers.

B. Comply with applicable requirements of NFPA 70E, "Electrical Safety Requirements for Employee Workplaces," latest edition.

C. Comply with applicable requirements of UL 486A and B, and UL 508, pertaining to installation of motor controllers. Provide controllers and components that are UL-listed and labeled.

D. Comply with applicable requirements of NEMA Standards ICS 2, "Industrial Control Devices, Controllers and Assemblies", and Pub. No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)", pertaining to motor controllers and enclosures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide motor controllers of one of the following (for each type and rating of motor controller):

1. Allen-Bradley Co.
2. Cerus Industrial.
3. General Electric Co.
4. Square D Co.
5. Danfoss-Graham.
6. Reliance.
7. Cutler-Hammer

2.02 MOTOR CONTROLLERS

A. Except as otherwise indicated, provide motor controllers and ancillary components which comply with manufacturer's standard materials, design and construction in accordance with published information, and as required for a complete installation.

B. Fractional HP Manual Controllers: Provide single-phase fractional HP manual motor controllers, of sizes and ratings required to operate the motors shown on the contract documents. Equip with manually operated quick-make, quick-break toggle mechanisms; and with one-piece melting alloy type thermal units. Controller to become inoperative when thermal unit is removed. Provide controllers with double break silver alloy contacts, visible from both sides of controller; green pilot lights, and switch capable of being padlocked OFF. Enclose controller unit in NEMA Type 1 general-purpose enclosure suitable for flush mounting; coat with manufacturer's standard color finish for indoor installation. Enclose controller unit in weatherproof general-purpose enclosure coated with manufacturer's standard color finish for outdoor installation and where device is exposed to moisture.

C. Magnetic Starter, Across-The-Line:

1. Motor starters shall be across-the-line magnetic type rated in accordance with NEMA Standards, sizes and horsepower ratings as required for the motor controlled. Starters shall be mounted in general-purpose enclosures unless otherwise indicated on plans.

2. Across-the-line magnetic starters through NEMA size seven shall be equipped with double break silver alloy contacts. Single break contacts shall be supplied on size eight starters. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter shall have straight-through wiring.

3. Coils shall be of molded construction through NEMA size seven. Coils on size eight starters shall be form wound, taped, varnished and baked. All coils shall be replaceable from the front without removing the starter from the panel.

4. Overload relays shall be the melting alloy type with a replaceable control circuit module. Thermal units shall be of one-piece construction and interchangeable. The starter shall be inoperative if the thermal unit is removed. Provide overload heaters to protect the motor to be controlled.

5. Provide one spare normally-open contact and one spare normally-closed contact in each NEMA size 0 through size 7 starters.

6. Magnetic starters with "Hand-Off-Auto" selector switch and Form C contact, as manufactured by Square D, or acceptable substitute, three-pole, three-phase of NEMA size applicable with three melting alloy overload relays and three-position H-O-A switch in cover of general purpose enclosure.

7. Provide starters of the proper NEMA size to control each motor. Do not provide starters smaller than NEMA size 0.

8. Provide starters with low voltage transformers.

PART 3 - EXECUTION

3.01 COORDINATION WITH DIVISION 26

A. Portions of the work will be provided under Division 26. Refer to Section 23 0512 for coordination of the work with Division 26.

3.02 EXAMINATION

A. Examine areas and conditions under which motor controllers are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.03 INSTALLATION OF MOTOR CONTROLLERS

A. Install motor controllers for each motor, in accordance with equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of NEC, UL and NEMA standards, to insure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

3.04 FIELD QUALITY CONTROL

A. Prior to energization of motor controller equipment, check with ground resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to insure requirements are fulfilled.

B. Prior to energization, check circuitry for electrical continuity, and for short-circuits.

C. Ensure that direction of rotation of each motor fulfills requirements.

D. Ensure that motor overloads are properly sized and installed.

3.05 GROUNDING

A. Provide equipment-grounding connections for motor controller equipment as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.06 ADJUSTING AND CLEANING

A. Adjust operating mechanisms, where necessary, for free mechanical movement.

3.07 DEMONSTRATION

A. Upon completion of installation of motor controller equipment and electrical circuitry, energize controller circuitry and demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

END OF SECTION 23 8965

SECTION 26 05 01
ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required to install, test, and provide an operational, electrical system as specified and as shown on the Drawings.

B. All equipment described herein shall be submitted and furnished as an integral part of equipment specified elsewhere in these Specifications.

C. All electrical work provided under any Division of the Specifications shall fully comply with the requirements of Division 26.

D. The work shall include furnishing, installing, and testing the equipment and materials detailed in each Section of Division 26.

E. The work shall include furnishing and installing the following:

1. Electrical service from the Power Company.

2. Provide a complete raceway system, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions. Coordinate construction schedule and electrical interface with the supplier of electrical equipment specified under other Divisions as required by the Contract Documents.

3. Provide a complete raceway system, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators, and control panels. Lightning and surge protection equipment wiring at process instrumentation transmitters. Install vendor furnished cables specified under other Divisions as required by the Contract Documents.

4. Provide a complete raceway system for the Data Cables and specialty cable systems, including those furnished under other Divisions. Install the Data Cables and other specialty cable systems, in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the Process Control System supplier and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished. Where redundant cables are furnished, install the cables in separate raceways as required by the Contract Documents.

5. Furnish and install precast electrical and instrumentation manholes, hand holes and light pole foundations as required by the Contract Documents. Pole foundations shall be designed and installed in accordance with the structural Divisions of these Specifications.

6. Coordinate the sequence of demolition with the sequence of construction to maintain plant operation in each area. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of treatment.

7. Make modifications to existing motor control centers, switchboards, panelboards, and motor controllers including installation of circuit breakers, etc., or disconnection of circuits as required to provide the power supplies to new and existing equipment to maintain the plant in operation.

8. All bidders shall visit the site of the project, prior to submitting a bid, and satisfy themselves as to any question that they might have, relating to existing equipment, condition, or construction.

9. Provide standby generation to keep the Owner's process in service as required by the Contract Documents.

10. New work includes but is not limited to the following: electrical system which include low voltage power distribution switchgear, medium and low voltage transformers, low voltage motor control equipment, low voltage motors, low voltage panelboards, lightning protection system, fire alarm system, security system, lighting systems and power system short circuit and protective device coordination studies.

F. Provide all electrical relocation work associated with the relocation of equipment for the existing and new facilities, including disconnecting all existing wiring and conduits and providing new wiring and conduit to the relocated equipment as specified in Section 26 05 05.

G. Maintain the Owner's process operations during all construction including any required electrical or control system outages. Prior to bidding, obtain all needed process operational requirements and restrictions from the Owner's staff during the site visits to determine the effect the operational restrictions may have on the construction schedule and/or bid price. Verify any process related information which may be shown or specified. If the obtained information conflicts with information in the Contract Documents, notify the Engineer in writing prior to bidding. As a minimum, include in the Contract Schedule and Bid Price the following items required to comply with operational requirements:

1. Additional Time and/or Expense.

2. Additional equipment, materials, and personnel.

3. Standby generation with fuel.

H. Provide all tools, equipment, supplies, and shall perform all labor required to install the equipment specified in the Contract Documents to install, test, and place into satisfactory operation in the time specified for completion in the Contract Documents. Failure of any of the participants in executing the requirements of this Contract to perform the work as specified shall not constitute an acceptable reason for the Owner to grant any change in the Contract Price or additions to the Contract Time.

I. The work includes demolition of existing electrical equipment, associated conductors, and raceway. Included is the removal of duct banks and manholes. The duct banks may contain asbestos. Visit the site and determine the size of the duct banks to be removed by inspection at the manholes and other places where the conduits transition from concealed to exposed. Include all labor and expense to remove the duct banks, dispose of all asbestos materials found, provide fill dirt to replace the volume of duct bank removed and compact to 95%. Reseed grass areas and repair streets or sidewalks disturbed by the removal of duct banks shown or specified to be removed.

1. Unless otherwise noted, remove all electrical materials and equipment from areas indicated for demolition.

2. Remove unused conduit to the extent necessary to accommodate new work and where conduit is visible above the floor line. Unused conduit which is concealed, or which does not interfere with the work, may remain in place. Seal abandoned conduit that remain in place behind walls or in floor slabs. Remove wiring from abandoned conduit.

3. Materials and equipment to be removed, except items specifically listed to be relocated or delivered to the Owner, become the property of the Contractor, and must be immediately removed from the project site.

4. Electrical services and controls to items being removed must be disconnected and removed as a requirement of this section.

5. Removal of any equipment must not interfere with existing operations.

6. The Owner reserves First Right of Salvage.

1.02 MEASUREMENTS AND PAYMENT

A. UNIT PRICES

1. This item will be measured and paid for as a lump sum for each lift station site.

2. Payment will be full compensation for all labor, equipment, materials and supervision for the demolition, cleanup and other related work necessary for construction as shown on the drawings and specified herein.

3. Refer to Section 01 22 00 – Unit Prices for unit price procedures.

1.03 ELECTRICAL WORK REQUIRED IN OTHER DIVISIONS

A. References made to other sections which may contain related work does not negate other related sections which may not be mentioned. The Contract Documents, which is defined to include both the Drawings and the Specifications, shall be taken with every section related to every other section as required to meet the requirements specified. The organization of the Contract Documents into specification divisions and sections is for organization of the documents themselves and does not relate to the division of suppliers or labor which the Contractor may choose to employ in the execution of the Contract.

B. Where references are made to other Sections and other Divisions of the Specifications, provide such information or additional work as may be required in those references, and include such information or work as may be specified. Examine all Sections of the Specifications and Drawings and determine the power and wiring requirements and provide external wiring and raceways, as required to provide a fully functioning power, control and process control systems. If the equipment requires more conductors and/or wiring, due to different equipment being supplied, provide the additional conductors, raceways and/or wiring, and include in the Contract Price and Schedule.

C. Examine all Specifications and Drawings, determining power and wiring requirements. Provide external wiring and raceways, as required to provide a fully functioning System. If the equipment requires more conductors and/or wiring due to different equipment being supplied, furnish the additional conductors, raceways and/or wiring with no change in Contract Price or Schedule.

1.04 SUBMITTALS

A. Submit Shop Drawings, in accordance with Division 1 requirements, for equipment, materials and all other items furnished under each Section of Division 26, except where specifically stated otherwise. An individually packaged submittal shall be made for each Section and shall contain all the information required by the Section. Partial submittals will not be accepted and will be returned without review.

B. Submittals will not be accepted for Section 26 05 01.

C. Each Section submittal shall be complete, contain all the items listed in the Specification Section, and shall be clearly marked to indicate which items are applicable on each cut sheet page. The Submittal shall list any exceptions to the Specifications and Drawings, and the reason for such deviation. Shop drawings, not so checked and noted, will be returned without review.

D. Check shop drawings for accuracy and contract requirements prior to submittal to the Owner/Engineer. Errors and omissions on approved shop drawings shall not provide relief from the responsibility of providing materials and workmanship required by the Specifications and Drawings. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to Specifications and Drawings. Only one Specification Section may be made per transmittal.

E. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered, or shop work started if the related shop drawings are marked "APPROVED AS NOTED CONFIRM", "APPROVED AS NOTED RESUBMIT", “REVISE AND RESUBMIT”, “REJECTED”, or "NOT APPROVED".

F. All approved shop drawings shall be maintained on site for the Owner’s Inspector and for the Owner’s Engineer to verify at the time of delivery of equipment to the job site.

G. Up-to-date Record Drawings shall be promptly furnished when the equipment installation is complete. Payment will be withheld until Record Drawings have been furnished and approved.

H. All shop drawing submittals and all O&M submittals shall be submitted in hard copy format and in electronic format using PDF files including a Table of Contents which is indexed on a flash drive with a minimum capacity of 32GB or larger as required. Electronic submittals are mandatory and those which are received not indexed as specified will be returned without review. Hard copy submittals may not be required if stipulated in the Contract Documents. No change in Contract Amount or Contract Time will be allowed for delays due to unacceptable submittals.

1.05 REFERENCE CODES AND STANDARDS

A. Electric equipment, materials and installation shall comply with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)

2. National Electrical Code (NEC)

3. Occupational Safety and Health Administration (OSHA)

4. NFPA 70 - National Electrical Code (NEC)

5. National Electrical Manufacturers Association (NEMA)

6. American National Standards Institute (ANSI)

7. Insulated Cable Engineers Association (ICEA)

8. International Society of Automation (ISA)

9. Underwriters Laboratories (UL)

10. Factory Mutual (FM)

11. Local Design Codes and Standards

12. Other applicable Codes and Standards as referenced in other design guideline specification sections.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

C. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization, or association, or between Laws and Regulations, the higher performance requirement shall be binding, unless otherwise directed by the Owner/Engineer.

D. In accordance with the intent of the Contract Documents, compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, full compliance with all Laws and Regulations always.

E. Comply with local, county, state and federal regulations and codes in effect as of date of purchase.

F. Equipment of foreign manufacture must meet all U.S. codes and standards.

G. Equipment and materials shall conform to the requirements of all specifications and to the criteria provided in data sheets for the project.

1.06 SERVICE AND METERING

A. The Power Company serving this project is CenterPoint Energy (CPE). Service shall be obtained at 480 volts, 3 phase, 4 wire, 60 Hz from a pad mounted transformer furnished and installed by CPE.

B. The power company will be responsible for the following work:

1. Furnishing and installing the primary overhead conductors and pole line.

2. Furnishing and installing the riser pole, primary cutouts, lightning arresters and grounding.

3. Furnishing and installing primary underground cables.

4. Furnishing and installing the transformer pad and grounding.

5. Furnishing and installing metering current transformers (CT's), meter and meter wiring.

6. Termination of secondary cables to the service transformer.

C. Include the following work in the Contract Price and Schedule:

1. Furnish and install the primary underground conduits in full compliance with Power Company standards.

2. Furnish and install secondary conduits in a steel reinforced concrete-encased duct bank and cables.

3. Furnish and install equipment pad for the utility's transformer in full compliance with Power Company standards.

4. Coordinate the electrical service installation with the Power Company.

D. Submit shop drawings for the following items to the power company for approval:

1. Equipment pad for utility pad mounted transformer.

E. No power outages are allowed without notifying the Owner at least 14 calendar days in advance using the Owner-provided shutdown forms. Total outages of more than 15 minutes at any facility are prohibited unless approved by the Owner. Standby generation shall be provided for all outages longer than 15 minutes. Liquidated Damages will be applied as specified for outages longer than 15 minutes when caused by the Contractor's construction activities.

1.07 HAZARDOUS AREAS

A. Equipment, materials, and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503.

B. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.

1.08 CODES, INSPECTION AND FEES

A. Equipment, materials, and installation shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all necessary permits and pay all fees required for permits and inspections.

C. Make all arrangements with the power company for obtaining electrical service, include all power company charges and all labor and material required for the electrical service in the Contract Price and Schedule.

1.09 SIZE OF EQUIPMENT

A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. The equipment shall be always kept upright during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

1.10 RECORD DRAWINGS

A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings". The Record Drawings and Specifications shall be kept up to date throughout the project.

B. The Record Drawings shall be reviewed in a meeting with the Owner/Engineer monthly.

C. Record Drawings shall accurately show the installed condition of the following items:

1. One line Diagram(s).

2. Raceways and pull boxes.

3. Conductor sizes and conduit fills.

4. Panel Schedule(s).

5. Control Wiring Diagram(s).

6. Lighting Fixture Schedule(s).

7. Lighting fixture, receptacle, and switch outlet locations.

8. Underground raceway and duct bank routing. The drawings shall include the measured width and height of the duct bank and shall survey the elevation of the top of the duct bank or record its depth of burial below grade at intervals not to exceed 50 feet along the entire length. Changes in direction between termination points shall be surveyed and recorded on the record drawings.

9. Plan view, measured dimensions and locations of switchgear, distribution transformers, substations, motor control centers and panelboards.

10. Modifications to controls, systems, or any piece of electrical equipment including field-verified existing controls and all changes clearly identified.

11. All protective device and electrical system monitoring device settings.

D. Submit a typical example of a schedule of control wiring raceways and wire numbers, including the following information:

1. Circuit origin, destination, and wire numbers

2. Field wiring terminal strip names and numbers.

E. As an alternate, submit a typical example of point-to-point connection diagrams showing the same information, may be submitted in place of the schedule of control wiring raceways and wire numbers.

F. Submit the record drawings and the schedule of control wiring raceways and wire numbers (or the point-to-point connection diagram) to the Owner/Engineer.

G. Retainage will not be paid until the point-to-point connection diagrams have been furnished to the Owner/Engineer.

1.11 EQUIPMENT INTERCONNECTIONS

A. Review shop drawings of equipment furnished under other related Divisions and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with Record Drawings.

B. Furnish and install all equipment interconnections.

1.12 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.

B. Material or equipment from a manufacturer, not submitted and approved for this project shall not be brought on site. Use of any such material or equipment, will be rejected, and shall be removed and replaced, with the approved material and equipment, with no change allowed in the Contract Price or Schedule.

C. Material and equipment shall be UL listed, where such listing exists and shall bear a UL label. No such material or equipment shall be brought onsite without the UL label affixed.

D. All material, products, equipment, and workmanship being furnished for the project shall be replaced if it does not meet the requirements of Contract Documents even if installed, with no change in Contract Price or Schedule.

1.13 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, successfully complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will be rejected and shall be removed and replaced with no change in Contract Price or Schedule.

B. Equipment and materials shall be handled and stored in accordance with the manufacturer's instructions, and as specified in the individual Specification Sections.

1.14 WARRANTIES

A. Manufacturer's warranties shall be provided as specified in each of the Specification Sections.

1.15 EQUIPMENT IDENTIFICATION

A. Identify all equipment (disconnect switches, separately mounted motor starters, control stations, etc.) furnished under Division 26 with the name of the equipment it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc., shall have nameplate designations as shown on the Drawings.

1.16 QUALITY ASSURANCE

A. Product Conformance Certificate and Quality Assurance Release. Submit an overall conformance certificate for electrical components signed by the person responsible for product quality. Specifically identify the purchased material or equipment by project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. Indicate that all requirements have been met and identify any approved deviations.

B. Field Inspection

1. Electrical work shall be inspected and approved by the local code inspectors, the project inspectors, and the Project Manager prior to starting the 7-day test or scheduling training.

2. Give a minimum of two days' notice to the Inspectors that the installation is ready for inspection and two days' notice to the Project Manager.

3. Concealed work shall be inspected and approved by code inspectors and project inspectors before it is covered:

a. Conduit with stub-ups, underground in duct banks before concrete is poured. Conduit in slabs, walls and ceilings, complete with boxes.

4. Electrical equipment and materials shall be inspected upon arrival by the Project Manager for compliance with specifications.

1.17 SITE CONDITIONS

A. Take the following site conditions into consideration when fabricating, erecting, installing and wiring electrical equipment under this contract:

1. Plant Location _____

   Houston, Tx

2. Plant Type and Size _____

3. Plant Site Elevation _____

4. Seismic Zone Zone 0

5. Wind Velocity 135 mph

6. Temperature, Min./Max.:

   a. Coldest Winter Month High 40 degrees F Low -20 degrees F

   b. Warmest Summer Month High 110 degrees F Low 90 degrees F

   c. Lowest Expected 11 degrees F

   d. Highest Expected 105 degrees F

7. Rainfall:

   a. Annual 45 inches

   b. Design 3.4 inches/hour, 8.4 inches/24 hours

8. Design Relative Humidity: 98 %

9. Station Barometric Pressure:

   a. Average Annual 29.5 inches Hg Absolute.

10. Utility Water Systems: Design Pressure Design Temp.

a. City Water _____PSI _____degrees F

PART 2 PRODUCTS

2.01 COMPONENT DESIGN

A. Components utilized in the construction of the material or equipment shall be of the latest proven design, new and in current production. Do not use obsolete components or components to be phased out of production.

2.02 FACTORY INSPECTION

A. Always provide free access with prior notice for the Project Manager to the shop where the material or equipment is being fabricated or tested. Provide reasonable facilities for inspection, witnessing tests, and examining records. Give 7-days notice prior to starting tests which are scheduled for factory inspection.

PART 3 EXECUTION

3.01 INTERPRETATION OF DRAWINGS

A. The Drawings do not show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

B. Install each three-phase circuit in a separate conduit unless otherwise shown on the Drawings.

C. Unless otherwise approved by the Owner/Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed. Submit a Request for Information for any conduit route which is not clearly identified as concealed or exposed in the Contract Documents prior to its installation.

D. Circuits shown as "home-runs" shall be field routed. The raceway system provided shall include all necessary fittings, supports and boxes for a complete code-compliant raceway installation. Field routed raceway shall avoid blocking access to equipment either existing or spaces planned for future equipment and shall avoid blocking personnel egress through doors or access hatches.

E. Verify the exact locations and mounting heights of lighting fixtures, switches, and receptacles prior to installation. Verify dimensions and ratings of equipment and materials to ensure proper fit and performance.

F. Install equipment and materials in accordance with the Drawings and manufacturer's written instructions. If field conditions necessitate changes in electrical installation, obtain approval from the City Engineer. Except where dimensions are shown, the locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Determine exact locations and obtain approval from the City Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the City Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown. Conductor voltage drop shall not exceed 2 percent for feeders and 3 percent for branch circuits.

H. Redesign of electrical or mechanical work, which is required due to the use of a pre-approved alternate item shall include the arrangement of equipment and/or layout other than that which is specified or shown herein. All additional work and materials required shall be provided with no change in the contract price or schedule. Redesign and detailed plans shall be submitted to the Owner/Engineer for approval.

I. Raceways and conductors for lighting, switches, receptacles and other miscellaneous low voltage power and signal systems as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Refer to riser diagrams for signal system wiring. Homeruns, as shown on the Drawings, identify raceways to be run exposed and raceways to be run concealed. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

J. Provide all conduit and conductors or data highway cables to RTU and/or PLC termination cabinets, where designated on the Drawings or otherwise required by the Specifications, the manufacture of the equipment, or submitted and approved systems. The conduit and conductors or data highway cables as shown on the interface drawings may not necessarily be shown on the floor plan.

K. Install conductors carrying low voltage signals (typically twisted shielded pair cables) in raceways totally separate from all other raceways containing power or 120-Volt control conductors. Do not combine conductors carrying low voltage signals in wireways without barriers or NEC code-compliant separation for their entire length in the wire way, and/or provide separate wireways to provide separation of the conductors. Low voltage signal conductors routed through manholes or hand holes shall be bundled and separated from other conductors.

L. Raceways and conductors for thermostats controlling HVAC unit heaters, exhaust fans and similar equipment are not shown on the Drawings. Provide raceways and conductors between the thermostats, the HVAC equipment, and the motor starters for a complete operating system. All raceways and power conductors shall be in accordance with Division 26. Raceways shall be installed concealed in all finished spaces and may be installed concealed or exposed in process spaces. Refer to the HVAC drawings for the locations of the thermostats and controls.

M. Raceways and conductors for the fire alarm, sound and page party systems are not shown on the Drawings. Provide raceways and conductors as required by the system manufacturer for a complete operating system. All raceways and power conductors shall be in accordance with Division 26. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in process spaces.

3.02 EQUIPMENT PADS AND SUPPORTS

A. Electrical equipment pads and supports, of concrete or steel including structural reinforcing and lighting pole foundations, are shown on the Structural Drawings.

B. Electrical equipment or raceways shall not be attached to or supported from sheet metal walls.

C. Electrical equipment pads shall be provided for all free-standing equipment. Dimensions shall be minimum 3-inches high with 3-inch extension from front and sides of equipment for equipment mounted against the wall and 3-inch extension on all sides when equipment mounted elsewhere.

3.03 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B. Unless measurements are shown on the drawings, the locations for stubbing up and terminating concealed conduits which are shown on the drawings are approximate. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors and locate the concealed conduit before the floor slab is poured.

C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Owner/Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No change in Contract Price or Schedule for such change will be allowed.

D. Seal all openings, sleeves, penetrations, and slots as specified in Section 26 05 33.

3.04 CUTTING AND PATCHING

A. Coordinate with Divisions 2 and 3 for cutting and patching.

B. Core drill holes in concrete floors and walls as required. Obtain written permission from the Owner/Engineer before core drilling any holes larger than two inches.

C. Schedule the installation of work to provide the minimum amount of cutting and patching.

D. Cutting or drilling holes for the installation of raceway through joists, beams, girders, columns, or any other structural members is strictly prohibited. If a structural member is cut or drilled, restore the structural member to its previous condition in complete accordance with the instructions of the Structural Engineer, with no change in contract price or schedule regardless of the extent of the repairs required to restore the member to its previous condition.

E. Cut opening only large enough to allow easy installation of the conduit.

F. Patching shall be of the same kind and quality of material as was removed.

G. The completed patching work shall restore the surface to its original appearance or better.

H. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

I. Remove rubble and excess patching materials from the premises.

J. Existing conduits are cut at the floor line of wall line, they shall be filled with grout of suitable patching material approved by the Structural Engineer.

3.05 INSTALLATION

A. Any work not installed according to the Drawings and this Section shall be subject to change as directed by the Owner/Engineer. No change in Contract Price or Schedule will be allowed for making these changes.

B. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

C. Electrical equipment shall always be protected against mechanical or water damage. Electrical equipment shall not be stored outdoors. Electrical equipment shall be stored in dry permanent shelters as required by each Specification Section. Do not install electrical equipment in its permanent location until structures are weather-tight. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and tested as directed by the Owner/Engineer or shall be replaced with no change in Contract Price or Schedule, at the Owner/Engineer's discretion.

D. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Owner/Engineer's discretion.

E. Repaint any damage to the factory applied paint finish using touch-up paint furnished by the equipment manufacturer. If the metallic portion of the panel or section is damaged, the entire panel or section shall be replaced, at no additional cost to the Owner.

F. NEMA 3R, 4 or 4X enclosures shall not have raceways entering from the top if the enclosure is installed in a damp or wet area. Should raceways be installed entering the top, the enclosure shall be replaced, and raceways re-routed to enter the side or bottom. Conductors, if installed, shall be removed, and replaced. Correction of raceways entering the top and conductor replacement shall be provided with no change in Contract Price or Schedule.

G. Conduits exiting tray in airconditioned indoor electrical rooms will enter the top of electrical enclosures. The location of these conduits shall be coordinated with the HVAC duct vents such that cold air will not blow on the conduits causing condensation which will enter the electrical enclosures. After installation, inspect the conduits while the HVAC system is running to ensure no condensation is forming and entering any electrical enclosure. Re-direct the air flow if possible or re-route the conduits to avoid condensation. Conductors in re-routed conduits shall be replaced, re-terminated. retested and the operation of the equipment retested with no change in the Contract Price or Schedule.

3.06 PHASE BALANCING

A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified in Section 26 05 19.

3.07 MANUFACTURER'S SERVICE

A. Provide manufacturer's services for testing and start-up of the equipment as listed in each individual Specification Section. All settings, including those settings and arc flash labels required by the Power System Study, shall be made to the equipment, and approved by the Owner/Engineer prior to energizing of the equipment.

B. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for manufacturer's warranty repairs.

3.08 TESTS AND SETTINGS

A. Test systems and equipment furnished under Division 26 and repair or replace all defective work. Adjust the systems as specified and/or required.

B. All tests required by the individual specification Sections shall be completed prior to energizing electrical equipment. Submit a sample test form or procedure. and submit the required test reports and data to the Owner/Engineer for approval at least two weeks prior to the startup of the tested equipment. Include names of all test personnel and initial each test.

C. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.

D. Check wire and cable terminations for tightness.

E. Check rotation of motors prior to energization. Disconnect driven equipment if damage could occur due to wrong rotation. If the motor rotates in the wrong direction, the rotation shall be immediately corrected, or tagged and locked out until rotation is corrected.

F. Verify all terminations at transformers, equipment, capacitor connections, panels, and enclosures by producing a 1 2 3 rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.

G. Provide mechanical inspection, testing and setting of circuit breakers, disconnect switches, motor starters, control equipment, etc. for proper operation.

H. Check interlocking, control, and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by schematic and wiring diagrams.

I. Check the ampere rating of thermal overloads for motors and submit a typed record to the Owner/Engineer of same, including MCC cubicle location and load designation, motor service factor, horsepower, full load current and starting code letter. If inconsistencies are found, new thermal elements shall be supplied and installed.

J. Verify motor power factor capacitor ratings.

K. Testing shall be scheduled and coordinated with the Owner/Engineer at least two weeks in advance. Provide qualified test personnel, instruments and test equipment.

L. Refer to the individual equipment sections for additional specific testing requirements.

M. Adjust the systems and instruct the Owner's personnel in the proper operation of the systems.

N. Test the electrical system to specification requirements and demonstrate correct installation and operation of equipment. O & M Manual shall be furnished prior to testing for reference during testing and corrections for final O & M.

O. Before the 7-days test, demonstrate the system to the wastewater inspectors and the Project Manager. Show the system to be fully operational. All alarms, safeties, central communication points, and local communication point must operate in both full-automatic and back-up modes. Use fresh water in the test medium.

P. Operate the system continuously for a period of 7 days in fully automatic, without failure, to qualify as acceptable. "Failure" is considered any problem that requires correction by process control instructions, maintenance personnel, such as: high or low water level, any motor alarm, power failure, phase failure, communication failure, PLC failure, process control software failure, requiring rewriting or transducer failure. This would exclude conditions not under the control of Contractor, such as: evident lightning strikes, 25-year rains, local power utility power failure longer than the specified duration of service. Failures due to uncontrollable situations would allow the 7-day test to continue, as soon as test conditions are restored, and the City Engineer is notified.

Q. The existing station shall remain in service during this test.

3.09 TRAINING

A. Provide manufacturer's training as specified in each individual section of the Specifications.

END OF SECTION

SECTION 26 05 05
ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. Refer to Section 26 05 01.

1.03 REFERENCES

A. Temporary wiring of systems to maintain operation of facilities while undergoing modifications and demolition shall be provided in accordance with:

1. NFPA 70 - National Electrical Code (NEC), Article No. 590 - Temporary Wiring

2. Local Electrical Code.

1.04 SUBMITTALS

A. Annotate existing drawings to sequence the demolition of systems, equipment removal and temporary hook-ups.
B. Schedule with Project Manager for required shut-downs to accommodate system demolition and installation of temporary facilities.

1.05 QUALITY ASSURANCE

A. Verify field measurements and circuiting arrangements as are shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to City Engineer before disturbing existing installation.

E. By beginning of demolition, installer shall accept existing conditions and warrants that he will maintain service to equipment and items not scheduled or indicated for removal, and that he will return to the City all items and systems in good operating condition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

2.02 DESIGN AND CONSTRUCTION

A. The temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC - Article No. 590.

PART 3 EXECUTION

3.01 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with utility company to provide continuous service to operating equipment.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, notify City of West University Utility Operations and get approval. Use personnel experienced in such operations.

D. Provide notification atleast one week before partially or completely disabling system. Minimize outage duration.

E. Adding Load to Existing Electrical System: Perform a load analysis to assure that the existing power distribution system (MCC, service, conductors, panel, breakers, feeders, branch circuits, etc.) is not overloaded if additional load is added to existing equipment.

F. Existing electrical conduit and wire may not be reused to feed new equipment except by written authorization from the City.

3.02 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. This includes all associated support and anchoring systems. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical wire, conduits, devices and equipment serving utilization equipment that has been removed.

G. Repair adjacent construction and finishes damaged during demolition and extension work. Repairs to include matching material type and color.

H. Maintain access to existing installations which remain active. Modify installation or provide access panel as appropriate. Cut abandon conduits in floors or slabs flush to surface, fill with concrete and path to match surface type and color.

I. Extend existing installations using the materials and methods specified for new work.

3.03 DISPOSAL AND SALVAGE

A. Salvaged electrical and instrumentation equipment as well as wiring of size four and larger will be removed from existing facilities for City's reuse.

B. Material and equipment which can be reused or salvaged remains the property of the City of West University. Equipment to be retained by the City of West University shall be delivered to a specified location by the Contractor.

C. Materials and equipment which cannot be reused or salvaged will be removed and disposed by the Contractor.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.05 INSTALLATION

A. Install relocated materials and equipment under the provisions of – Division 02.

B. Electrical installations and materials shall conform to the current issue of the following standard and codes: NFPA 70 - National Electrical Code (NEC), Local Electrical Code, and material and workmanship.

C. All material shall be free of defects and in safe working condition which will meet electrical classification and functional requirements.

D. Testing shall be made during the course of construction or at the completion of the job. These tests shall be made by the electrical contractor. The contractor shall furnish all test equipment.

E. The job will not be complete until work has been inspected and trial startup has been successfully completed.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.

B. This Section shall apply to all temporary and permanent feeders used on the project.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

1.03 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.04 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted. Completed engineer's data sheets.

3. Completed manufacturer's data sheets.

4. Manufacturer's cut sheets, catalog data.

5. Installation, terminating and splicing procedure.

6. Instruction for handling and storage.

7. Dimensions and weight.

8. Conformance certificate

B. Shop Drawings

1. Submit catalog data of all wire and cable, connectors, and accessories, specified under this Section with all selections, options and exceptions clearly indicated. All cut sheets shall be clearly marked to indicate which products are being submitted for use on this project to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

C. Certified Tests

1. Submit a test report of all installed wire insulation tests.

2. Conformance Certificate and Quality Assurance Release: Submit a conformance certificate signed by the person responsible for product quality. The certificate shall specifically identify the purchased material or equipment, such as by the project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. The certificate shall indicate that requirements have been met and identify any approved deviations.

1.05 REFERENCE CODES AND STANDARDS

A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NFPA 70 – National Electrical Code (NEC)

2. NEMA WC-5 – Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

3. ANSI/TIA/EIA 606A – Standard for telecommunications Infrastructure

4. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 310 - Conductors for General Wiring

B. Underwriters' Laboratories (UL):

1. UL 44: Standard for Thermoset-Insulated Wire and Cable

2. UL 83: Thermoplastic Insulated Wires and Cables

3. UL 1063: Machine Tool Wires and Cables

C. American Society for Testing and Materials (ASTM):

1. ASTM B 3: Soft or Annealed Copper Wires

2. ASTM B 8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

3. ASTM B 33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.

4. ASTM B 174 - Bunch-stranded Copper Conductors for Electrical Conductors

D. Insulated Cable Engineers Association (ICEA):

1. ICEA S-61-402 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

2. ICEA S-66-524 - Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 7).

3. ICEA S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8). Insulated Cable Engineers Association (ICEA),

4. ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5)

E. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables and Field Splices.

1.06 QUALITY ASSURANCE

A. The general construction of the wire, cables and the insulation material used shall be like that used for cable of the same size and rating in continuous production for at least 15 years and successfully operating in the field in substantial quantities.

B. Wire and cable with a manufacture date of greater than 12 months previous will not be acceptable.

C. Wire and cable shall be in new condition, with the manufacturer's packaging intact, stored indoors since manufacture, and shall not have been subjected to the weather. Date of manufacture shall be clearly visible on each reel.

D. The manufacturer of these materials shall have produced similar electrical materials for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

E. Tests: Cable shall be tested at the factory to confirm that the cable complies with requirements of Part 6 of ICEA S-61-402, S-66-524 or S-68-516. Refer to data sheet for additional test requirements.

F. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.07 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer prior to delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.

B. Check for reels not completely restrained, reels with interlocking flanges or broken flanges, damaged reel covering or any other indication of damage. Do not drop reels from any height.

C. Unload reels using a sling and spreader bar. Roll reels in the direction of the arrows shown on the reel and on surfaces free of obstructions that could damage the wire and cable.

D. Store cable on a solid, well drained location. Cover cable reels with plastic sheeting or tarpaulin. Do not lay reels flat.

1.08 WARRANTY

A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for one year from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Wires and cables shall be annealed, 98% conductivity, soft drawn copper.

B. All conductors shall be Class B stranded.

C. Except for control, signal and instrumentation circuits, wire smaller than #12 AWG shall not be used.

2.02 POWER & BUILDING WIRE

A. Design. Provide cable with the following design characteristic. Cable shall be UL 44 or UL 83 listed, rated 600 volts and certified for continuous operation at the temperature as specified on the 600 Volt Power Cable Data Sheets while installed in underground duct, conduit, or cable tray. Cables shall be single-conductor or multi-conductor (with ground) as specified on the data sheets.

B. Conductors. Provide conductors which are Class B, concentric stranded, annealed copper coated, unless otherwise specified on the data sheets, with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516. The number and size of conductors supplied in each cable shall correspond to the quantities specified on the data sheets.

C. Insulation. Insulate each conductor as specified on the 600 Volt Power Cable Data Sheets to meet the requirements of Part 3 of ICEA S-61-402, S-66-524 or S-68-516. The insulation thickness shall match the dimensions listed in Section 3.2, Table 3-1 of ICEA S-61-402, S 66 524 or S-68-516, as specified on the data sheets.

D. Jacket.

1. When power cables are to be enclosed in conduit, ducts or in other raceway systems, multiconductor power cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket as specified on the Data Sheets, which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.

2. Single-conductor cables shall have a jacket thickness which meets the requirements of Table 4-4 of Part 4 of ICEA S-66-524, Table 4-2 of Part 4 of ICEA S-68-516, or Table 4-2 or 4-6 of Part 4 of ICEA S-61-402. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-2 of Part 4 of ICEA S-68-516, Table 4-5 of Part 4 of ICEA S-68-516, or Table 4-6 of Part 4 of ICEA S-61-402, unless otherwise specified on the data sheets.

E. Armor. When power cables are to be exposed in a cable tray, cable channel or other cable support systems, the multiconductor power cables shall be protected by an interlocked metal armor made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524 unless otherwise specified on the data sheets. An over-all jacket shall be provided as specified in the data sheets.

F. Cable Marking. Print cable marking information on the overall cable jacket at 2-foot intervals. Use a permanent printing method and color sharply contrasting with the jacket color. Identify individual conductors as specified on the data sheets in conformance with Part 5 of ICEA S-61-402, S-66-524, and S-68-516.

G. All building wire shall be stranded copper conductors, Type XHHW-2

H. Manufacturers

1. Southwire

2. General Cable

3. Okonite

4. Approved equal.

2.03 VARIABLE FREQUENCY DRIVE CABLE

A. Cable for use with VFDs shall be symmetrical design, three stranded Class D, tinned copper, circuit conductors with XLPE insulation, three bare copper grounds, 100% shields with 50% overlap, and overall PVC jacket. Cable shall be 2000 volt, UL 1277 Type TC, XHHW-2 rated, 90°C., IEEE 1202/383.

B. Manufacturers

1. Belden
2. General Cable
3. Southwire
4. Okonite
5. Approved equal.

2.04 TRAY CABLE

A. Cable for tray use shall be stranded copper conductors, Type XHHW-2 insulation, rated as UL Type TC cable. Cable shall be sunlight resistant and approved for direct burial.

B. Manufacturers

1. Southwire
2. General Cable
3. Okonite
4. Approved equal.

2.05 GROUNDING ELECTRODE CONDUCTOR

A. Grounding electrode conductor shall be stranded copper conductor, Type XHHW-2 with green insulation.

B. Manufacturers

1. Southwire
2. General Cable
3. Okonite

4. Approved equal.

2.06 BONDING JUMPER

A. Bonding Jumper shall be bare tinned stranded copper conductor.

B. Manufacturers

1. Southwire
2. General Cable
3. Okonite
4. Approved equal.

2.07 CONTROL WIRE AND CABLE

A. Control wire shall be NEC Type XHHW-2.

B. Multi-conductor control cable, shall be stranded, #14 AWG 600-volt, XHHW-2, insulated, PVC outer jacket overall, Type TC, UL rated for underground wet location.

C. Manufacturers

1. Southwire
2. Okonite
3. General Cable
4. Belden Division, Cooper Industries, Inc.
5. Approved equal.

2.08 INSTRUMENTATION CABLE

A. Design. Provide cable with the following design characteristics. The cable shall consist of multiple conductors. The cable assembly shall be UL listed, flame, oil and sunlight resistant, and certified for continuous operation at the temperature specified on the 600-Volt Control Cable Data Sheets in wet or dry locations while installed in underground duct, conduit, or cable tray. The number and size of conductors supplied in each cable shall correspond to the quantities specified on the 600-Volt Control Cable Data Sheets.

B. Conductors. Provide conductors who are concentric or bunch-stranded, annealed tinned copper with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 or ASTM B 174 and Part 3 of ICEA S-61-402, S-66-524, or S-68-516 unless otherwise specified on the 600-Volt Control Cable Data Sheets.

C. Insulation. Each conductor shall be insulated as specified on the 600-Volt Control Cable Data Sheets complying to the requirements of Part 3 of ICEA S-61-402, S-66-524 or S-68-516. The average insulation thickness shall not be less than the dimensions shown in Section 3.2, Table 3-1 of ICEA S-61-402, S-66-524 or S-68-516 for 600-volt insulation unless otherwise specified on the 600-Volt Control Cable Data Sheets. The minimum insulation thickness shall not be less than 90 percent of the value given in the table.

D. Drain Wire. Provide drain wire Class B, seven-stranded, tin-coated copper in accordance with ASTM B 3, ASTM B 8, or ASTM B 33 and as specified on the 600-Volt Control Cable Data Sheets.

E. Shielding. Cable shielding shall consist of laminated, nonburning, mylar-backed aluminum tape applied helically around conductors with the aluminum side in continuous contact with the drain wire unless otherwise specified on the 600-Volt Control Cable Data Sheet. The tape shall be wrapped around the conductors with a 25 percent minimum overlap unless otherwise specified on the 600-Volt Control Cable Data Sheets.

F. Jacket.

1. When control cables are to be enclosed in conduit, ducts or in other raceway systems, the cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket, as specified on the 600-Volt Control Cable Data Sheets, which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.

2. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-5 of Part 4 of ICEA S-68-524, or Table 4-6 of Part 4 of ICEA S-61-402 unless otherwise specified on the 600-Volt Control Cable Data Sheets.

G. Armor. Where control cables are to be exposed, as in cable tray, cable channel or other cable support systems, the cables shall be protected by an interlocked metal tape armor made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524 unless otherwise specified on the 600-Volt Control Cable Data Sheets. An over-all jacket shall be provided as specified in the Data Sheets.

H. Conductor Identification. Identify individual conductors by method as specified on the 600-Volt Control Cable Data Sheets in conformance with Appendix L of ICEA S-66-524, Part 5 of ICEA S-68-516, or Appendix I of ICEA S-61-402.

I. Cable Marking. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with a color sharply contrasting the jacket color. See the 600-Volt Control Cable Data Sheets for the minimum information required.

J. Cables for 4-20 ma, RTD, potentiometer and similar signals intended for circuits in accordance with Article 725 of the National Electric Code shall be PLTC rated and shall be as follows:

1. Single pair cable:

a. Conductors: Two #16 AWG stranded, tinned, and twisted on two-inch lay

b. Insulation: PVC with 600-volt, 90°C rating

c. Shield: 100% Mylar tape with drain wire

d. Jacket: PVC with manufacturer's identification

e. UL1685 listed for underground wet location use

2. Three conductor (triad) cable:

a. Conductors: Three #16 AWG stranded, tinned, and twisted on two-inch lay

b. Insulation: PVC with 600-volt, 90°C rating

c. Shield: 100% Mylar tape with drain wire

d. Jacket: PVC with manufacturer's identification

e. UL1685 listed for underground wet location use

3. Multiple pair cables (where shown on the Drawings):

a. Conductor: Multiple pairs, #16 AWG stranded, tinned, and twisted on a two-inch lay

b. Insulation: PVC with 600-volt, 90°C rating

c. Shield: Individual pairs shielded with 100% Mylar tape and drain wire

d. Jacket: PVC with manufacturer's identification

e. UL1685 listed for underground wet location use.

2.09 COMMUNICATION CABLES

A. Cables for Ethernet and RS485 shall be rated and shall be:

1. Category 5e above Grade shielded Cable.

a. Conductors: Four bonded pair #24 AWG Bare Copper

b. Insulation: Polyolefin

c. Shield: 100% aluminum foil polyester tape with drain wire

d. Jacket: PVC with 600-volt rated and manufacturer's identification

e. UL21047 and UL1666 listed for indoor and dry locations use

f. Manufacturers

1) Belden 7957A

2) Approved equal.

2. Category 5e above Grade un-shielded Cable

a. Conductors: Four bonded pair #24 AWG Bare Copper

b. Insulation: Polyolefin

c. Jacket: PVC with 300-volt rated and manufacturer's identification

d. NEC CMR

e. UL1666 listed for indoor and dry locations use

f. Manufacturers

1) Belden 7923A

2) Approved equal.

3. Category 6 above Grade shielded Cable.

a. Conductors: Four bonded pair #23 AWG Bare Copper

b. Insulation: Polypropylene

c. Shield: 100% aluminum foil polyester tape with drain wire

d. Jacket: PVC with 600-volt rated and manufacturer's identification

e. Transmission Standards: Category 6 - TIA 568.C.2

f. NEC CMR

g. Flame Test Method: UL1666 Vertical Riser listed for indoor and dry locations use

h. Manufacturers

1) Belden 7953A

2) Approved equal.

4. Category 6 above Grade un-shielded Cable.

a. Conductors: Four bonded pair #23 AWG Bare Copper

b. Insulation: Polyolefin

c. Jacket: PVC with 300-volt rated and manufacturer's identification

d. Transmission Standards: Category 6 - TIA 568.C.2

e. Nominal Velocity of Propagation: 72%

f. Flame Test Method: UL1666 Vertical Riser listed for indoor and dry locations use

g. Manufacturers

1) Belden 7940A

2) Approved equal.

5. Category 5e below Grade shielded Cable.

a. Conductors: Four pair #24 AWG Bare Copper

b. Insulation: Polyolefin

c. Shield: 100% aluminum foil polyester tape with drain wire

d. Jacket: LLPE (Linear Low-Density Polyethylene) with 300-volt rated and manufacturer's identification

e. Misc.: NEMA WC-63.1, listed for outdoor and wet locations use

f. Water Blocking compound and listed for direct bury applications.

g. Manufacturers

1) Belden 7937A

2) Black Box

3) Approved equal.

6. Category 5e below Grade unshielded Cable

a. Conductors: Four pair #24 AWG Bare Copper

b. Insulation: Polyolefin

c. Jacket: LLPE (Linear Low-Density Polyethylene) with 300-volt rated and manufacturer's identification

d. Misc.: NEMA WC-63.1, listed for outdoor and wet locations use.

e. TIA-568-C.2 Category 5e compliance

f. Water Blocking compound and listed for direct bury applications.

g. Manufacturers

1) Belden 7934A

2) CommScope Ultra II 5NF4

3) Approved equal.

7. Category 6 below Grade Cable

a. Conductors: 4 pair 23AWG Bare Copper

b. Insulation: Polyolefin

c. Shield: 100 percent aluminum foil polyester tape with drain wire

d. Jacket: Polyethylene with 300 volts rated and manufacturer's identification

e. Misc.: Gel filled and NEMA WC-63.1, listed for outdoor and wet locations use

f. Manufacturers:

1) CommScope SYSTIMAX GigaSPEED X10D 1571

2) Approved equal.

8. 485 Communications Cable

a. Conductors: One pair #24 AWG Tinned Copper

b. Insulation: Polyethylene

c. Shield: 100% aluminum foil polyester tape with tinned copper drain wire

d. Jacket: PVC with 300-volt rated and manufacturer's identification

e. Misc.: UL2919 listed for indoor and dry locations use

f. Manufacturers

1) Belden 9841

2) Approved equal.

B. Color code for Ethernet communications cables shall be as follows.

1. Green – CAT5e Phone / Data
2. Red – CAT5e SCADA
3. Blue – CAT6 – Phone / Data
4. White – CAT6 – SCADA
5. Green – Phone / Data
6. Red – FIRE Alarm
7. Blue – SCADA
8. Green – Phone
9. Red – FIRE / Security
10. Blue – Administrative Network
11. Yellow – SCADA

2.10 TERMINATION MATERIALS

A. Power Conductors: Termination materials, of conductors at equipment, shall be as specified in the relevant equipment Section.

B. Control and Instrumentation Conductors (including graphic panel, alarm, low- and high-level signals): Termination connectors shall be DIN-rail-mounted one-piece molded plastic blocks with tubular-clamp-screw type, with end barriers, dual side terminal block numbers and terminal group identifiers. Terminals to be UL Listed for stranded conductor terminations. Rated for a maximum of 2 #14 stranded conductors. Color of terminals to comply with NFPA 79.

C. Manufacturers

1. Phoenix Contact
2. Entrelec
3. Weidmuller
4. Allen Bradley
5. Approved equal.

D. Motor Conductors: Motor connections with conductors #12 AWG up to #6 AWG shall be ring type compression terminations on the motor leads and secured with bolt, nut and spring washer. Connections shall be -30°C rubber insulated, half lap, and two layers minimum of Scotch 33 or equal vinyl tape. Motor terminations for conductors #8 AWG and larger shall be in accordance with paragraph "Lugs and Connectors" below. Motors provided on this project per specification 16150 and / or 16151 shall have motor terminals enclosures with bus and NEMA one-hole or two-hole pads to accommodate the conductor terminals specified herein.

E. Lugs and Connectors

1. All lugs and connectors shall be tin plated copper and shall be crimped type, installed with standard industry tooling. Lugs, where specified to be used, and connectors shall all match the wire size and shall be clearly identified, and color coded on the connector. All connections shall be made for stranded wire and shall be made electrically and mechanically secured. The lugs and connectors shall have a current carrying capacity equal to the conductors for which they are rated and meet UL 486 requirements for 75°C. Lugs for #12 AWG up to #6 AWG shall be ring terminals. Conductors #4 AWG and larger shall be two-hole long barrel lugs with NEMA spacing. All lugs shall be the closed end construction to exclude moisture migration into the cable conductor.

2.11 SPLICE MATERIALS

A. Power Conductors: Circuits shall be pulled from terminal to terminal, without splicing, except where splicing is shown on the Drawings. No other splicing will be permitted. For wires sizes #8 AWG and smaller, provide color coded wire nuts, with metal inserts, 3M or Ideal, rubber insulated with half lap and two layers minimum of Scotch 33 tape. For wires greater than #8 AWG, provide a heat shrink insulated, color-coded, die-crimped splice lug, T&B 54XXX, or equal, rubber insulated, with half lap and two layers minimum of Scotch 33 tape.

B. Control and Instrumentation Conductors (including graphic panel-, alarm-, low- and high-level signals): No splicing of control and instrumentation conductors will be permitted.

2.12 WALL AND FLOOR SLAB OPENING SEALS

A. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp. or equal.

2.13 WIRE AND CABLE TAGS

A. Use the tagging formats for wire and cable as shown on the Drawings. Where modifications or additions are made to existing wire and cable runs, replace existing tags with new modified tags.

B. Wire tags for wire sizes, #2 AWG and smaller, shall be heat shrink type Raychem TMS-SCE, or equal with the tag numbers typed with an indelible marking process. Character size shall be a minimum of 1/8-inch in height. Hand-written tags shall not be acceptable. Where ends are not available, attach cable tags with nylon tie cord.

C. Tags for wires larger than #2 AWG and all cables shall be thermally printed polyethylene type, Brady TLS 2200 or equal, nylon zip tied in accordance with the manufacturer's instructions.

D. Tags relying on adhesives or taped-on markers are not acceptable.

E. Tagging shall be done in accordance with the execution portion of these Specifications.

2.14 WIRE COLOR CODE

1. All wire shall be color coded or coded using electrical tape in sizes #8 or greater, where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.

2. The following coding shall be used:

System	Wire	Color
1-Phase, 3 Wire	Phase A	Black
	Phase B	Blue
	Neutral	White
208Y/120, Volts	Phase A	Black
3-Phase, 4 Wire	Phase B	Red
	Phase C	Blue
	Neutral	White
240/120, Volts	Phase A	Black
3-Phase, 4 Wire	Phase B	Orange
	Phase C	Blue
	Neutral	White
480/277, Volts	Phase A	Brown
3-Phase, 4 Wire	Phase B	Purple
	Phase C	Yellow
	Neutral	Gray
Motor Control	1	Black
	2	Red
	3	Blue

2.15 CABLE TAG COLOR CODE

A. All cable tags shall be white in color with black printing.

PART 3 EXECUTION

3.01 GENERAL

A. Do not install conductors until the raceway system is in place. No conductor shall be installed between outlet points, junction points or splicing points, until raceway sections have been completed, and raceway covers are installed for protection of conductors from damage or exposure to the elements. Any conductor installed in an incomplete raceway system shall be removed from the raceway system and from project site. A complete inspection of such raceway sections shall be completed before new conductors are installed.

B. Installed unapproved wire shall be removed and replaced at no additional cost to the Owner.

C. Completely swab raceway system before installing conductors. Do not use cleaning agents and lubricants which have a deleterious effect on the conductors or their insulation.

D. Pull all conductors into a raceway at one time, using wire pulling lubricant as needed to protect the wire.

E. Except for hand-pulled conductors into raceways, all wire and cable installation shall be installed with tension-monitoring equipment. Conductors which are found to have been installed without tension–monitoring shall be immediately removed from the raceways, permanently identified as rejected material, and removed from the jobsite. New conductors and cables shall be reinstalled, tagged and raceways resealed, with no change in the Contract Price or Schedule allowed.

F. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Where pulling compound is used, use only UL listed compound compatible with the cable outer jacket and with the raceway involved.

G. Tighten all screws and terminal bolts using torque type wrenches and/or drivers to tighten to the inch-pound requirements of the NEC and UL.

H. Single conductors and cables in manholes, hand holes, vaults, cable trays, and other indicated locations are not wrapped together by some other means such as arc and fireproofing tapes, shall be bundled throughout their exposed length with nylon, self-locking, releasable, cable ties placed at intervals not exceeding four inches on centers.

I. All wire and cable installed in cable trays shall be UL Listed as Type TC, for cable tray use.

3.02 CONDUCTORS 1000 VOLTS AND BELOW

A. Provide conductor sizes indicated on Drawings, as a minimum.

B. Use crimp connectors on all stranded conductors.

C. Soldered mechanical joints insulated with tape will not be acceptable.

D. Arrange wiring in cabinets and panels neatly cut to proper length Surplus wire shall be removed unless noted otherwise. Conductors shall be bridled or bundled and secured in an acceptable manner. Identify all circuits entering motor control centers and all other control enclosures in accordance with the conductor identification system specified herein.

E. Terminate control and instrumentation wiring with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.

F. Attach compression lugs, larger than #6 AWG, with a tool specifically designed for that purpose which provides a complete, controlled crimp where the tool will not release until the crimp is complete. Use of plier type crimpers is not acceptable.

G. Cap spare conductors and conductors not terminated with the UL listed end caps.

H. Remove all burrs, chamfer all edges, and install bushings and protective strips of insulating material to protect the conductors passing through holes or over edges in sheet metal enclosures.

I. Provide at least 6 feet spare conductors in freestanding panels and at least two feet spare in other assemblies for all conductors which are to be terminated by others. Provide additional conductor length in any assembly where it is obvious that more conductor will be needed to reach the termination point.

J. Do not combine power conductors in the same raceway unless shown on Drawings. Do not run signal conductors carrying voltages less than 120 volts AC in the same raceway as conductors carrying higher voltages regardless of the insulation rating of the conductors. Do not share neutrals on branch circuits.

K. Install medium voltage (5 kV and 15 kV) and 600V cables in separate trays.

3.03 GROUNDING

A. Conduits and other raceways shall contain an equipment grounding conductor whether the raceway is metallic or not. Conduits, motors, cabinets, outlets, and other equipment shall be properly grounded in accordance with NEC requirements and specification 16660. Ground wires exposed to mechanical damage shall be installed in rigid aluminum conduit. Make connections to equipment with solderless connections. Connections to ground rods shall be of the fused type equal to the Cadweld process or equal.

3.04 TERMINATIONS AND SPLICES

A. No splices of wire and cable will be permitted, except where specifically permitted by the Owner/Engineer in writing, or as shown on the Drawings.

B. Power conductors: Terminations shall be made with connectors as specified. Splices, where specifically allowed as stated above, shall be made in a Termination Cabinet (TC).

C. Control Conductors: Splices of control conductors will not be permitted between terminal points. Terminations shall be made with approved terminals as specified.

D. Instrumentation Signal Conductors (including graphic panel-, alarm-, low- and high-level signals): Splices of Instrumentation conductors will not be permitted between terminal points. Terminations shall be made with connectors as specified. The shield of pair shielded, and triad shielded shall be terminated on terminal strips. Provide dedicated terminal block to every conductor including shields. Double lugging terminations is not acceptable.

3.05 INSTRUMENTATION CABLES

A. Instrumentation cables shall be installed in raceways as specified. Unless specifically shown on the Drawings, all instrumentation circuits shall be installed as single shielded twisted pair cables or single shielded twisted triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.

B. Terminal blocks shall be provided at all instrument cable junction boxes, and all circuits shall be identified at such junctions.

C. Shielded instrumentation wire, coaxial cable, data highway cable, discrete I/O, multiple conductor cable, and fiber optic cables shall be run without splices between instruments, terminal boxes, or panels. The shield shall be continuous for the entire run.

D. Shields shall be grounded at the PLC/RTU. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Individual circuit shielding shall be provided with its own block.

E. Shield wire shall be wrapped and taped at the transmitter end of the signal run. Before termination, peel back the outer sheath, leaving the shield intact. Wrap the drain wire around the conductors, leaving approximately two inches exposed. Wrap the drain wire with two layers of Scotch 33 tape.

F. Cable in Tray

1. Install armored cable in cable tray.

2. 600-Volt Tray rated Control Cable may be installed in cable tray with 600-volt Tray rated power cables provided a barrier between signal and power cables are installed.

3. Install cables in trays in a neat and orderly manner. Tie cables to the rungs at approximate 15-foot intervals by use of cable ties.

3.06 WIRE TAGGING

A. All wiring shall be tagged at all termination points and at all major access points in the electrical raceways. A termination point is defined as any point or junction where a wire or cable is physically connected. This includes terminal blocks and device terminals. A major access point to a raceway is defined as any enclosure; box or space designed for wire or cable pulling or inspection and includes pull boxes, manholes, and junction boxes.

B. Wire tags shall show both origination and destination information to allow for a wire or cable to be traced from point in the field. Information regarding its origination shall be shown in parenthesis.

C. For multiconductor cables, both the individual conductors and the overall cable shall be tagged. Conductors that are part of a multiconductor cable shall reference the cable identification number that they are a part of, as well as a unique conductor number within the cable.

3.07 CABLE TAGGING

A. All cables shall be tagged at all termination points and at all major access points in the electrical raceways as defined in the wire tag section of this Specification.

B. The cable tag shall be installed where the cable enters and leaves each access point (e.g., junction box, manhole, etc.). In cases of limited access space, a single tag may be used that shows both equipment tag origination and destination. In the case where the jacket is stripped for terminations, the tag shall be installed at the end of the jacket.

3.08 RACEWAY SEALING

A. Raceways entering junction boxes or control panels containing electrical or instrumentation equipment shall be sealed with 3M 1000NS Watertight Sealant or equal.

B. This requirement shall apply to for all raceways in the conduit system.

3.09 FIELD TESTS

A. Conductors under 600 volts

1. Perform insulation resistance testing of all power circuits below 1000 volts with a 1000-volt megger, in accordance with the recommendations of the wire manufacturer.

2. Prepare a written test report of the results and submit to the Owner/Engineer prior to final inspection.

3. Minimum acceptable value for insulation resistance is 100 megohms. Lower values shall be acceptable only by the Owner/Engineer's specific written approval.

4. Disconnect equipment that might be damaged by this test. Perform tests with all other equipment connected to the circuit.

B. Tests: After instrumentation cable installation and conductor termination by the instrumentation and control supplier, perform tests to ensure that instrumentation cable shields are isolated from ground, except at the grounding point in the instrumentation control panel. Remove all improper grounds.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install a complete Grounding and Bonding System, in strict accordance with Article 250 of the National Electrical Code (NEC), and as shown on the Drawings and specified herein.

B. The system shall include ground wires, ground rods, exothermic connections, mechanical connectors, structural steel connections, all as shown on the Drawings, and as specified herein, to provide a bonding to earth ground of all metallic materials likely to become energized.

C. Include the following:

1. Grounding electrodes and conductors
2. Equipment grounding conductors
3. Bonding
4. Power system grounding
5. Communication system grounding
6. Electrical equipment and raceway grounding and bonding
7. Control equipment grounding
8. Soil resistivity measurements
9. Grounding system resistance to earth measurements

1.02 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

B. Submit to the Engineer shop drawings and product data, for the following:

1. Ground rods.

2. Grounding conduit hubs.

3. Waterpipe ground clamps.

4. Buried grounding connections.

5. Compression lugs.

6. Exothermic bonding system.

7. Manufacturer's cut sheets and catalog data

8. Installation, terminating and splicing procedure.

9. Instruction for handling and storage

10. Dimensions and weight

11. Soil resistivity measurements for each structure having a counterpoise grounding system and for each structure having a lighting protection system specified or shown to be installed.

12. Grounding system resistance to earth measurements for each structure having a counterpoise grounding system and for each structure having a lighting protection system specified or shown to be installed.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

B. American Society for Testing and Materials (ASTM)

1. ASTM B3: Soft or Annealed Copper Wires

2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

3. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes

C. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142-82: Recommended Practice for Grounding of Industrial and Commercial Power Systems

2. IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

3. Underwriters' Laboratories (UL)

D. UL 83: Thermoplastic Insulated Wire and Cables

1. UL 467: Grounding and Bonding Equipment

E. National Fire Protection Association

1. (NFPA), NFPA No. 70 - National Electrical Code (NEC), Article No. 250 - Grounding.

2. NFPA 70 – National Electrical Code (NEC)

3. NFPA 70E – Standard for Electrical Safety in the Workplace

F. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Tests

1. Use insulated cable conforming to requirements of the vertical tray flame test as described in IEEE 383-2.5.

2. Test grounding system in the field in accordance with procedures outlined in Part 3 – Execution.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer prior to delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.

B. Protect equipment during shipment, handling, and storage by suitable complete enclosures. Protect equipment from exposure to the elements and keep thoroughly dry.

1.07 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 RACEWAYS

A. Conduit shall be provided as specified under Section 26 05 33.

B. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum size of the grounding conductors shall be #12 AWG unless otherwise indicated on the drawings. Equipment grounding conductors larger than the NEC minimums shall be provided as shown on the drawings.

2.02 CONDUCTORS

A. Conductors shall be as specified under Section 26 05 19.

B. Equipment grounding conductors shall be insulated XHHW-2 conductors. Conductors shall be green where available from the wire manufacturers or marked with green tape as specified under 26 05 19.

C. Grounding electrode conductors shall be bare tinned copper where direct buried or encased in concrete. Bare grounding electrode conductors or lightning protection conductors where exposed to damage shall be installed in conduit. Grounding electrode conductors or lightning protection down lead conductors shown, specified, or required to be installed in conduit per the NEC with no other conductors shall be bare tinned copper. Bare conductors installed in metallic conduits shall be bonded to the metallic conduit at both ends.

D. Grounding electrode conductors routed between concealed grounding electrodes or interconnecting grounding electrode counterpoise loop conductors to exposed (IE “Pigtails”) shall be bare tinned copper.

2.03 GROUNDING ELECTRODES

A. Ground rods shall be 3/4-inch by 10-foot copper clad steel or stainless steel and constructed in accordance with UL 467. The minimum copper thickness on cooper clad ground rods shall be 10 mils.

B. Manufacturers for ground rods

1. ERICO
2. Copperweld
3. Blackburn Grounding
4. Thomas & Betts
5. Approved equal.

2.04 CONNECTORS AND CONNECTIONS

A. Waterpipe ground clamps shall be 316 stainless steel. Provide the correct size for the pipe.

1. Manufacturers
    a. Thomas & Betts Co. Cat. JPT
    b. Burndy
    c. O.Z. Gedney Co.
    d. Cooper Power Systems
    e. Erico
    f. Harger
    g. Approved equal
    h. Other grounding system clamps, where specified or shown shall be 316 stainless steel.
2. Manufacturers
    a. Thomas & Betts Co.
    b. Burndy
    c. O.Z. Gedney Co.
    d. Cooper Power Systems
    e. Erico
    f. Harger

g. Approved equal.

B. All concealed grounding system or lightning protection system connections shall be by an exothermic weld process.

1. Manufacturers

a. T&B Furseweld SCR1

b. Burndy Thermoweld

c. Cadweld

d. Approved equal.

2. Exothermic welded connections shall be used in exposed locations as specified herein.

C. Provide a Burndy Hyground Irreversible Compression System or equal in areas where the Owner's operations prevent the use of an exothermic welded connection. The use of a compression system ground connection is otherwise prohibited without written approval on a case-by-case basis from the Owner or Engineer. Permission shall be submitted through the RFI process. Compression connectors installed without permission shall be removed and replaced with exothermic weld connections with no change in the Contract Price or change in the Contract Schedule allowed.

D. All grounding connections which would require exothermic welding in a Class 1 Division 1 Area as determined by NFPA 820, or the Engineer, or the NEC Authority Having Jurisdiction shall use a Burndy Hyground Irreversible Compression System, or equal.

PART 3 EXECUTION

3.01 MATERIALS AND EQUIPMENT

A. Design. Provide grounding cable and materials with the following characteristics:

1. Use a grounding system designed in accordance with NEC Article No. 250 Grounding, and the IEEE 142-82 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

B. Materials

1. Use grounding conductors, tin plated bare or insulated, which are manufactured and tested in accordance with applicable standards ASTM B3, ASTM B8 and ASTM B33.

2. Provide a main ground loop of No. 4/0 AWG, Class C stranded, bare copper cable. Unless otherwise shown or specified, small groups of isolated equipment may be grounded by a No. 2 AWG minimum insulated conductor connected to the main loop. Unless otherwise shown or specified, generally, taps shall be sized as follows:

a. Main ground loop or grid #4/0 minimum

b. Switchgear, motor control centers and power transformers #4/0

c. Motors 200 hp and above #4/0

d. Power panels - AC and DC #2/0

e. Control panels and consoles #2

f. Building columns #4/0

g. Fencing posts #2/0

3. Single conductor insulated grounding conductors shall use 600-volt insulation. Use ground conductors identified with green insulation or green tape marking.

4. Supply identifying ribbon, which is PVC tape, 3 inches wide, red color, permanently imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" in black letters as specified in Section26 05 53 – Identification for Electrical Systems.

5. Utilize tin plated flexible copper braid across hinged chain link or fence gates to bond the movable portion to the grounded fence post.

3.02 CONSTRUCTION CRITERIA

A. Unless otherwise shown or specified, the following criteria shall be followed:

1. The main ground loop at a depth of at least 30 inches below earth surface. Connect the ground loop to ground rods and to tap connections to form a complete system as indicated on the electrical Drawings. The grounding of service equipment, structures and fences to comply with the NEC, local authorities and the serving utility company.

2. Electrical equipment, buildings, tanks, and other structures and equipment shall be grounded as indicated on the Drawings. Where ground rods are required, the rods shall be 10 feet long, 3/4-inch diameter, copper-clad steel ground rods. Rods shall be driven vertically, and the top of the rods shall be a minimum of 18 inches below finished grade, or as specified on the Drawings. Ground wells will be provided for all driven rods.

3. Local pushbutton and selector switch stations, two-wire control devices, disconnect switches, lighting transformers, panelboards, operator panels, benchboards, and the enclosures of other electrical apparatus shall be grounded through, and equipment grounding conductor run with the power supply or control circuit conductors or shall be grounded as shown on the Drawings.

4. Ground medium voltage motors, in addition to the grounding conductors in the motor feeder cable, with a separate No. 4/0 AWG cable to motor frame.

5. Motors having power supplied by multiconductor cable shall be grounded by a separate grounding conductor in the cable and where supplied by single conductor cable in conduit by a grounding conductor pulled in the conduit. Connect ground conductors to the ground bus in the motor control center and to the ground terminal provided in the motor conduit box.

6. Do not ground the insulated bearing pedestals of large motors.

7. Connect ladder-type cable trays to the grounding electrode system.

8. Install a warning ribbon approximately 12 inches below finished grade directly above the ground grid.

9. Connect fence posts of chain link and metal fences to the main ground loop at least every 50 feet. Install bonding straps to gates.

3.03 INSTALLATION

A. Route exposed grounding electrode conductors in rigid aluminum conduits to protect the conductors from damage. The rigid conduits shall be aluminum or PVC-coated aluminum conduits as specified in 26 05 33. Bond the protecting conduits to the grounding electrode conductors at both ends. Water pipe grounding connections shall not be painted. Painted connections shall be disassembled, replaced, and reconnected.

B. Install equipment grounding conductors in all raceways for the power, control, and instrumentation systems. Grounding conductors shall be independent conductors and shall be separate from all shield drain wires.

C. Conduits and other raceways shall contain an equipment grounding conductor whether the raceway is metallic or not. Conduits, motors, cabinets, outlets, and other equipment shall be properly bonded in accordance with NEC requirements. Where ground wire is exposed to mechanical damage, install wire in rigid metallic conduit.

D. In NEC classified areas, connection of grounding electrode connections to structural steel columns shall be made with long barrel type one-hole heavy duty copper compression lugs, bolted through 1/2-inch maximum diameter holes drilled in the column web, with stainless steel hex head cap screws and nuts.

E. NOTE TO DESIGNER: where “as shown on the drawings…” appears, check to be sure it is shown or remove the phrase. Select below if the building steel is to be connected to the grounding electrode conductors using lugs crimped on the grounding conductor or exothermic welds. In corrosive areas, exothermic welds are suggested.

F. In new construction, bond each building column to the grounding electrode counterpoise system whether nor not specifically shown on the Drawings using grounding electrode conductors. Grounding electrode conductors rising from the counterpoise to bond to a column shall be made using an insulated conductor the same size as the conductors used to form the counterpoise. Exposed grounding electrode conductors shall be routed in rigid aluminum PVC-coated aluminum conduit. Bond metallic conduits as specified. Grounding electrode conductor connections to structural steel columns shall be made with as permitted by the Structural Engineer with long barrel type one-hole heavy duty copper compression lugs, bolted through 1/2-inch maximum diameter holes drilled in the column web, with stainless steel hex head cap screws and nuts. Exothermic welds are acceptable in non-classified areas if approved by the Structural Engineer.

G. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connected to the motor control center ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250.122, except that a minimum #12 AWG shall be used.

H. Liquid tight flexible metal conduit in sizes 1-1/2-inch and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.

I. Ground transformer neutrals to the nearest available grounding electrode with a conductor sized as shown with a minimum size in accordance with NEC Article 250.66.

J. Provide power system grounding electrodes (ground rods) no closer than twice the length of the ground rod. Where a lightning protection is specified to be provided, l provide a dedicated lightning protection system grounding electrode (ground rod) at the end of every down lead if no counterpoise is present, or l connect directly to the power system counterpoise without driving a separate ground rod. Refer to Section 26 41 13 for lightning protection system specifications.

K. Provide a #1/0 AWG bare tinned grounding conductor the full length of each cable tray system, bond each section and tray fitting to the tray grounding conductor. Route the tray grounding conductor along the outside of the cable tray. Install no grounding clamps on the inside of the tray to avoid damage to tray conductors. Bond the tray grounding conductor to the power system counterpoise grounding electrode system at the end of the tray, or for tray systems installed in a loop configuration, bond in at least two locations at opposite sides of the tray loop. Bond every enclosure to which tray conductors are routed to the tray grounding conductor. Bond every conduit or raceway routing tray conductors away from or to the tray system to the cable tray and to the cable tray grounding conductor.

L. All equipment enclosures, motor and transformer frames, conduits systems, cable tray, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded, and bonded in accordance with the NEC.

M. Seal exposed connections between different metals with no-oxide paint, Grade A or equal.

N. Lay all underground grounding conductors' slack and, where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

O. Care shall be taken to ensure good ground continuity, between the conduit system and equipment frames and enclosures. Where necessary, bonding jumper conductors shall be provided.

P. Ground all grounding type receptacles to the outlet boxes with a minimum, #12 AWG XHHW-2 stranded green conductor, connected to the ground terminal of the receptacle, and bonded to the outlet box by means of a grounding screw.

Q. Equipment Grounding. As a minimum unless otherwise shown or specified, the following shall be provided:

1. Make grounding connections to surfaces which are dry and cleaned of paint, rust, oxides, scales, grease, and dirt to ensure good conductivity. Clean copper and galvanized steel to remove oxide before making welds or connections.

2. Use the exothermic welding process for below-grade grounding connections, except at ground rods. Use mechanical connectors or thermal connections for above-grade grounding connections as shown on the Drawings.

3. Make grounding connections to electrical equipment, vessels, mechanical equipment, and ground rods in accordance with the Drawings.

4. Ground tanks and vessels by making connections to integral structural supports or to existing grounding lugs or pads, and not to the body of the tank or vessel. Tanks which have cathodic protection shall not be grounded unless such grounding is approved by a NACE certified engineer.

5. Leave ground connections to equipment visible for inspection. Protect them with PVC non-metallic conduit as indicated on the Drawings.

6. Make connections to motor frames and ground buses with lugs attached to the equipment by means of bolts. Do not use motor anchor bolts or equipment housing for fastening lugs of grounding cable.

7. Where the wiring for lighting systems consists of single conductor cables in conduit, provide each conduit with an equipment grounding conductor. Use a grounding conductor with green colored insulation and ground equipment in the lighting system.

R. Raceway and Support Systems Grounding. As a minimum unless otherwise shown or specified, the following shall be provided:

1. Install raceway, cable rack or tray and conduit so that it is bonded together and permanently grounded to the equipment ground bus, according to the Drawings. Connection to conduit may be grounding bushing or ground clamp.

2. Install raceway at low voltage motor control centers or other low voltage control equipment so that it is bonded and grounded, except that any conduit which is effectively grounded to the sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded.

3. Where a grounding conductor is run in or on a cable tray, bonds the grounding conductor to each section of cable tray with a cable tray ground clamp.

4. Where only grounding conductor is installed in a metal conduit, bond both ends of the conduit to the grounding conductor.

5. Provide flexible "jumpers" around raceway expansion joints. Use copper bonding straps for steel conduit. Install jumpers across cable tray joints which have been parted to allow for expansion and any hinged cable tray connections.

6. Fences and Gates. Ground fences, fence posts and gates to the underground grid as shown on the Drawings.

S. Power System Grounding. As a minimum unless otherwise shown or specified, the following shall be provided:

1. Solidly ground the secondary neutral of the main power supply transformer either to the ground grid or through an impedance. See Drawings for details.

2. Solidly ground the neutral of lighting, instrument, and control transformers.

T. Cable Armor and Shields. As a minimum unless otherwise shown or specified, the following shall be provided:

1. For shielded control cable, terminate and ground the shield at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by jumping the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.

2. Connect the ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not carry these ground wires through a "doughnut" current transformer (CT) used for ground fault relaying; do carry ground leads from stress cones through CTs. Ground power cable armor and shield at each terminal point.

U. Test Wells. As a minimum unless otherwise shown or specified, the following shall be provided:

1. Provide access (test wells) for testing the ground grid system at one or several ground rod locations. Make test wells of a concrete body surrounding the rod and connections with a cast iron cover placed on top at grade level indicated as GROUND. rod and connections with a cast iron cover placed on top at grade level indicated as ground. The ground rod well shall be a minimum 12" in diameter and 12" in length reinforced concrete provided by National Lightning Protection or equal. See Drawings for details.

2. Install a test well at the service entrance pole to serve as the service entrance grounding electrode.

3.04 INSPECTION AND TESTING

A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.

B. Use Biddle Direct Reading Earth Resistance Tester or equivalent test instrument to measure resistance earth resistivity at each structure having a counterpoise grounding system or a lightning protection system. Measure the earth-to-ground of each system having a counterpoise grounding system or a lightning protection system installed. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

C. All test equipment shall be provided under this Section and approved by the Owner/Engineer.

D. Resistance to ground testing shall be preceded by no precipitation for a minimum of five days. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.

E. Testing shall be performed before energizing the electrical distribution system.

F. A separate test shall be conducted for each building or system.

G. Notify the Engineer immediately if the resistance to ground for any building or system is greater than five ohms.

H. Perform soil resistivity measurements prior to the installation of any grounding systems and submit the results to the Engineer.

I. Perform ground resistance tests after underground installation and connections to building steel are complete, unless otherwise noted on applicable Drawings.

J. Make tests at each ground test well using a "fall of potential" test method. Each ground test well shall not exceed a maximum resistance of 5 ohms. Where measured values exceed this figure, install additional ground rods as required to reduce the resistance to the specified limit.

K. Submit the results of the ground-to-earth tests to the Owner and the Engineer.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install hangers and supports for electrical systems, as shown on the Drawings and as specified herein.

B. Hardware shall include anchor systems, adhesive anchor systems, metal framing systems, and other electrical support systems, as shown on the Drawings and specified herein.

1.02 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

B. The submittal information, for anchor systems, shall contain manufacturer's specifications and technical data including:

1. Acceptable base material conditions (i.e., cracked, un-cracked concrete)

2. Acceptable drilling methods

3. Acceptable bore hole conditions (dry, water saturated, water filled, under water)

4. Manufacturer's installation instructions including bore hole cleaning procedures and adhesive injection.

5. Cure and gel timetables

6. Temperature ranges (storage, installation and in-service).

C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NFPA 70 National Electrical Code (NEC)

2. NFPA 70E Standard for Electrical Safety in the Workplace

3. ASTM E 488-96 (2003); Standard Test Method for Strength of Anchors in Concrete and Masonry Elements, ASTM International.

4. ASTM E 1512-93, Standard Test Methods for Testing Bond Performance of Adhesive-Bonded Anchors, ASTM International

5. AC308; Acceptance Criteria for Post-Installed Anchors in Concrete Elements, Latest revision.

6. SAE 316 Stainless Steel Grades

B. All equipment components and completed assemblies having a UL standard specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, a list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, all submittal requirements must be complete, and an approved copy of all such submittals shall be available to the Owner/Engineer prior to delivery of the equipment. Delivery of equipment not completely constructed, onsite factory work, or failed factory tests will not be permitted.

B. Materials shall be handled and stored in accordance with manufacturer's instructions.

C. Adhesive Anchor Systems.

1. Deliver materials undamaged in Manufacturer's clearly labeled, unopened containers, identified with brand, type, and ICC-ES Evaluation Report number.

2. Coordinate delivery of materials with scheduled installation date, minimizing storage time at jobsite.

3. Store materials under cover and protect from weather and damage in compliance with Manufacturer's requirements, including temperature restrictions.

4. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

5. Do not use damaged or expired materials.

6. Storage restrictions (temperature range) and expiration date must be supplied with product

D. Metal Framing Systems

1. Material shall be new and unused, with no signs of damage from handling.

1.07 WARRANTY

A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for one year from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENTS AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 ANCHORING SYSTEMS

A. Acceptable Manufacturers

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

a. HILTI Kwik Bolt 3

b. Approved equal.

2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Product Description

1. Torque controlled expansion anchor consisting of anchor body, expansion element (wedges), washer and nut. Anchor shall be used for anchor sizes less than 3/8 inch.

2. All parts shall be 316 stainless steel materials conforming to SAE 316.

3. UL 203 Rated.

2.02 ADHESIVE ANCHORING SYSTEMS

A. Acceptable Manufacturers

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

a. HILTI HIT-RTZ with HIT-HY 200 MAX.

b. Approved equal.

c. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Product Description

1. Anchor body with helical cone shaped thread on the embedded end and standard threads on the exposed end, with washer and nut, inserted into Injection adhesive. Anchor shall be used for anchor sizes 3/8 inch and larger.

2. All parts shall be 316 stainless steel materials conforming to SAE 316 standards.

2.03 STRUT SUPPORT SYSTEMS

A. Acceptable Manufacturers

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

a. Tyco Unistrut

b. Eaton

c. Thomas & Betts Super-Strut

d. Approved equal.

e. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Product Description

1. Metal framing system for use in the mounting or support of electrical systems, panels, and enclosures, and including lighting fixture supports, trapeze hangers and conduit supports.

2. Components shall consist of telescoping channels, slotted back-to-back channels, end clamps all threads and conduit clamps.

3. Minimum sizes shall be 13/16-inch through 3-1/4 inch.

4. Components shall be assembled by means of flat plate fittings, 90-degree angle fittings, braces, clevis fittings, U-fittings, Z-fittings, Wing-fittings, Post Bases, channel nuts, washers, etc.

5. Field welding of components will not be permitted.

6. Unless otherwise specified or shown on the Drawings, all parts shall be 316 stainless steel material conforming to SAE 316.

7. Framing systems for chlorine and ammonia rooms shall be manufactured of structural fiberglass.

2.04 STAINLESS TIES

A. Acceptable Manufacturers

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

a. Panduit

b. Phoenix Contact

c. Gardner Bender

d. Approved equal.

2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Product Description

1. Cable Ties for securing and supporting of flexible raceway and conductors.

2. Self-locking mechanism.

3. Material shall be 304 Stainless Steel unless otherwise directed as shown on the drawings.

C. Locations for Use

1. Cable Ties of stainless steel to be used in wet environments, where exposed to process, or when exposed to sunlight

2. Self-locking mechanism.

PART 3 EXECUTION

3.01 GENERAL

A. Install all equipment strictly in accordance with the manufacturer's instructions and the Contract Drawings.

B. The locations of devices are shown as general on the Drawings and may be varied within reasonable limits as to avoid any piping or other obstruction without change in the Contract Price or Schedule, subject to the approval of the Owner and Engineer. Coordinate the installation of the devices for piping and equipment clearance.

C. No electrical equipment or raceways shall be attached to or supported from, sheet metal walls.

D. Install required safety labels.

E. Electrical support channel shall be used to construct support assemblies as shown on the drawings. Horizontal braces attached to concrete or CMU walls or structural building steel are permitted if the space between the back of the support structures and the attachment points are too small to permit a walk space. No attachments to sheet metal are permitted as specified above. Incorporate additional channel materials and/or provide assemblies of double channel with enough vertical and horizontal members to from a rigid structure even if such additional materials or the use of double channel materials are not shown or specified. Support structures shall be rigid without the use of channels to from angle supports between the back or front of the assembly and the ground. Angle supports are strictly prohibited because they provide tripping hazards. Outdoor supports structures shall be able to support the equipment with the structural strength to withstand wind gusts up to 90 mph without damage.

3.02 FIELD QUALITY CONTROL

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

3.03 POST INSTALLED ANCHOR SYSTEMS

A. Prior to installation of the anchor systems, the hole shall be clean and dry in accordance with the manufacturer’s instructions.

3.04 CLEANING

A. Remove all rubbish and debris from inside and around the installation. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

END OF SECTION

SECTION 26 05 33
RACEWAYS, BOXES, ENCLOSURES, AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein. A raceway system shall consist of materials designed expressly for containing wires and cables, including but not limited to, conduit, device bodies, conduit bodies, raceway boxes, enclosures containing electrical devices, controls, and related materials.

B. Raceways indicated to be run "exposed" on the schedules shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors, and hatches, etc. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

1.02 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Instruction for handling and storage.

4. Installation instructions.

5. Dimensions and weights.

B. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

C. Submit to the Owner/Engineer, certification that the electricians installing the PVC coated conduit have a five-year minimum experience, in the installation of the product.

D. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NFPA 70 – National Electrical Code (NEC)

2. NFPA 70E – Standard For Electrical Safety in the Workplace

3. ANSI C80.5 – Electrical Rigid Aluminum Conduit

4. UL 514B – Outlet Bodies

B. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer.

C. The installer of materials specified herein, shall have a minimum of five years' experience in the installation of each type of material. Proof of experience shall be submitted, upon request of the Owner/Engineer, prior to installation.

D. Used materials are unacceptable, will be rejected and shall be removed from the job site. Used materials, if installed, shall be removed, and replaced with new materials. If new materials are installed with used materials, and the removal of the used materials renders the new materials in an unacceptable condition, such as new conductors installed in used raceway components, (determined by the Engineer/Owner alone) then the new materials shall be removed along with the used materials and replaced. No increase in the Contract Price nor in Contract Schedule will be allowed.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer prior to delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.

B. Materials shall be handled and stored in accordance with manufacturer's instructions.

C. Materials shall not be stored exposed to sunlight. Such materials shall be completely covered.

D. Materials showing signs of previous use, jobsite storage at another location, or exposure to the elements or other damage will be rejected.

1.07 WARRANTY

A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for one year from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

1. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 GENERAL

A. Raceways and fittings shall be as shown on the Drawings, with a minimum 3/4-inch trade size.

B. Device entries less than 3/4 inch shall be provided with an adaptor to connect ¾-inch or larger conduit. The following adaptors are acceptable:

1. REA12SA, Eaton or equal, for aluminum

2. ADAPT ADU302930, REDAPT or equal, for 316 stainless.

3. Approved equal.

2.02 CONDUIT RACEWAY

A. PVC Coated Rigid Aluminum Conduit (CRMC)

1. PVC coated rigid aluminum conduit shall have a minimum 0.040-inch thick, polyvinyl chloride coating permanently bonded to rigid aluminum conduit and an internal chemically cured urethane or enamel coating. Urethane coating shall be a minimum of 2 mil thickness on the interior of the conduit and the interior of fittings, condulet, covers, and bodies.

2. Rigid Aluminum conduit shall be extruded from AA 6063 alloy in temper designation T-1 and shall conform to FED Spec WW-C-540C, ANSI C80.5 and UL 6A.

3. The ends of all couplings, fittings, etc. shall have a minimum of one pipe diameter in length of PVC overlap.

4. Manufacturers for PVC coated conduit and fittings

    a. Perma-Cote

    b. Robroy Industries

    c. O'Kote, Inc.

    d. Calbond

    e. Ocal.

    f. NEC Inc (BlackGuard)

    g. Approved equal.

5. Elbows and couplings shall be PVC coated by the same manufacturer supplying the conduit PVC coating system. Elbows and couplings used with PVC coated conduit shall be furnished with a PVC coating bonded to the aluminum, the same thickness as used on the coated aluminum conduit.

B. Liquid tight Aluminum Flexible Metal Conduit (LFMC)

1. Liquid tight aluminum flexible metal conduit shall have an interlocked aluminum core, PVC jacket rated for 60 degrees C, and meeting NEC Article 351.

2. Manufacturers

    a. Anaconda Metal Hose Div.

    b. Southwire

    c. Anaconda American Brass Co.

    d. American Flexible Conduit Co., Inc.

e. Universal Metal Hose Co.

f. ALFLEX

g. Approved equal.

3. Fittings used with liquid tight flexible aluminum conduit shall be copper-free aluminum and shall conform to FEDSPEC AA50552, and UL-514B.

4. Couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501 & 502, and Federal Specification W-C-586 C.

C. Aluminum Flexible Metal Conduit (FMC)

1. Aluminum flexible metal conduit shall have an interlocked aluminum core, meeting NEC Article 348, UL 1and Federal Specification WW-C-566C.

2. Manufacturers

a. Anaconda Metal Hose Div.

b. Southwire

c. Anaconda American Brass Co.

d. American Flexible Conduit Co., Inc.

e. Universal Metal Hose Co.

f. Approved equal.

3. Fittings used with aluminum flexible metal conduit shall be copper-free aluminum shall conform to FEDSPEC AA50552.

D. Rigid Aluminum Conduit (RMC)

1. Rigid Aluminum conduit shall be extruded from AA 6063 alloy in temper designation T-1 and shall conform to FED Spec WW-C-540C, ANSI C80.5 and UL 6A.

2. Manufacturer for rigid aluminum conduit and fittings

a. Wheatland Tube Company

b. Allied

c. American Conduit

d. Patriot Industries

e. Approved equal.

E. Rigid PVC Schedule 40 Conduit (RNC)

1. Schedule 40 PVC Rigid Nonmetallic Conduit (RNC) shall be designed for use underground as described in the NEC, resistant to sunlight. The conduits and fittings shall be manufactured to NEMA TC-2, Federal Specification WC1094A and UL 651 specifications. Fittings shall be manufactured to NEMA TC-3, Federal Specification WC1094A and UL 514B. Conduit shall have a UL Label.

2. Manufacturers

a. Rocky Mountain Colby

b. Carlon

c. Kraloy

d. Heritage Plastics

e. Approved equal.

F. Rigid PVC Schedule 80 Conduit (RNC)

1. Schedule 80 PVC Rigid Nonmetallic Conduit (RNC) shall be designed for use above ground and underground as described in the NEC, resistant to sunlight. The conduits and fittings shall be manufactured to NEMA TC-2, Federal Specification WC1094A and UL 651 specifications. Fittings shall be manufactured to NEMA TC-3, Federal Specification WC1094A and UL 514B. Conduit shall have a UL Label.

2. Manufacturers

a. Rocky Mountain Colby

b. Carlon

c. Kraloy

d. Heritage Plastics

e. Approved equal.

2.03 WIREWAYS

A. All wireways shall be NEMA 4X 316 stainless steel, with gasketed hinged covers and stainless steel quick-release type latches. Wireway shall have two Breather/Drains for each ten feet of wireway. Breather/Drain shall be in the bottom, near the ends of the wireway. Wireways shall have integral welded mounting lugs. Bolted-on mounting lugs are unacceptable. Provide stainless steel internal barriers to isolate signal cables from power conductors and multiconductor digital control cables.

B. Manufacturers

1. Industrial Enclosure Corporation

2. Eaton

3. Approved equal.

C. Breather/Drains

1. Eaton 316 stainless steel

2. Approved equal.

2.04 RACEWAY BOXES AND EQUIPMENT ENCLOSURES

A. The term box and enclosure are synonymous for this specification. Boxes and enclosures specified herein, include terminal boxes, junction boxes pull boxes, and boxes for switch, receptacles, and lighting. Enclosures used for electrical and instrumentation equipment, other than terminal boxes, shall be provided as described in this section with references to this specification in other specification sections. All raceway boxes and equipment enclosures shall be provided with a common ground point and shall be UL rated.

B. NEMA Type 4X boxes shall be 316 stainless steel or aluminum only as otherwise specified or shown with mounting lugs or brackets welded on the box, suitable for wall mounting, or have mounting feet where self-standing. Boxes for wall-mounting shall have integral welded-on mounting lugs. Enclosures with mounting feet shall have the mounting feet brackets for the attachment of mounting feet welded on. Boxes manufactured with holes intended for mounting using bolted-on mounting lugs or feet are not acceptable. Drilling through the back of the box to mount is strictly prohibited. Drilled boxes shall be removed and replaced. All boxes shall have continuously welded seams ground smooth, and shall have continuous hinged, gasketed doors. Box bodies shall not be less than 16 gauge. Boxes larger than 24 inches X 20 inches shall have a three-point type latch with handle. Boxes 24 inches X 20 inches or smaller shall have 316 stainless steel luggage type quick release latches, or three-point latch system with all components 316 stainless steel. Latch systems requiring tools to open or close are unacceptable.

C. NEMA 4X 316 Stainless Steel enclosures

1. Use for all locations unless otherwise shown or specified

2. Type 316 stainless steel, body, and door

3. Stainless steel continuous hinge

4. Foam in-place gasket

5. Single point quarter turn latches (20-inch X 24-inch and smaller). All others shall have three-point

6. Manufacturers

    a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.

    b. Eaton

    c. Hoffman

    d. Appleton Electric

    e. EMF Company

    f. NEMA Enclosures Company

    g. Rittal

    h. Approved equal.

D. NEMA 4X Aluminum where shown on the drawings boxes shall be constructed as follows:

1. Type 5052 aluminum, body, and door

2. Stainless steel continuous hinge

3. Foam in-place gasket

4. Single point quarter turn latches (20-inch X 24-inch and below). All others three-point latch

5. Manufacturers

    a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.

    b. Hoffman

c. EMF Company

d. NEMA Enclosures Company

e. Eaton

f. Approved equal.

E. NEMA 6P Stainless stees Submersible [Where shown on the Drawings] boxes shall meet NEMA 6P, 4, 4X, and IP68 shall be constructed as follows:

1. 14 gauge (minimum) 316 Marine Grade Stainless Steel body, and door

2. Stainless steel continuous hinge

3. Seems continuously welded and dressed.

4. Single piece Neoprene gasket

5. Minimum flange width to maximize internal capacity.

6. Mounting brackens welded on enclosure for direct wall mounting

7. Grounding stud on body

8. Mounting stud for optional internal mounting plates

9. #3 polish finish Continuous stainless-steel hinge as shown, specified or required.

10. Manufacturers

    a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.

    b. Slayson

    c. Approved equal

F. Chemical Rooms and areas specified or shown to be corrosive: NEMA 4X nonmetallic boxes shall be constructed as follows:

1. PVC or Fiberglass reinforced polyester body and door.

2. UV inhibitors

3. UL Listed

4. RoHS compliant

5. Formed in place polyurethane gasket in continuous channel.

6. 316 Stainless steel quick release latches.

7. Manufacturers

    a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.

    b. Allied Molded Products, Inc.

    c. Cantex

    d. Eaton

    e. Hoffman

    f. Hubbell-Wiegmann Non-Metallic

    g. Approved equal.

G. Classified Areas, NEMA 7/4X boxes (Class 1, Division 1, Groups A, B, C, and D, or as defined in NFPA 70) shall be constructed as follows:

1. Copper free cast aluminum body and cover

2. Stainless steel hinges

3. Watertight neoprene gasket

4. Stainless steel quarter turn cover bolts with metallic handles] [Stainless steel quick release latches.

5. Manufacturers

    a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.

    b. Eaton

    c. Appleton Electric

    d. Approved equal.

H. NEMA 12 boxes where shown on the drawings shall be constructed as follows:

1. Type 5052 aluminum, body and door
2. Stainless steel continuous hinge
3. Foam in-place gasket
4. Single point quarter turn latches (20-inch X 24-inch and below). All others three-point latch
5. Manufacturers
    a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.
    b. Hoffman
    c. EMF Company
    d. NEMA Enclosures Company
    e. Eaton
    f. Approved equal.

I. NEMA 1 or NEMA 1A boxes shall not be used.

J. Malleable iron boxes shall not be used.

2.05 DEVICE BOXES

A. Device boxes installed in aluminum raceway systems for switches and receptacle, etc., shall be copper free cast aluminum, and shall have tapered, threaded, hubs, with integral bushings. Boxes shall have internal grounding screw, and a minimum of two mounting feet. Boxes shall be type FD.

B. Manufacturers

1. Eaton
2. Appleton
3. Approved equal.

2.06 CONDUIT OUTLET BODIES

A. Conduit outlet bodies and covers shall be Form 7, copper-free aluminum, with captive screw-clamp cover, neoprene gasket and stainless-steel screws and clamps for conduits up to and including 2-1/2 inches.

B. Manufacturers

1. Eaton Form 7 with Mark 7 wedge-nut cover

2. Appleton

3. Approved equal.

C. Provide junction boxes for conduits larger than 2-1/2 inches.

D. All outlet boxes and covers for Class 1 Division 2 areas shall be rated NEMA 4X.

1. Manufacturers

a. Eaton EA Series

b. Approved equal.

2.07 CONDUIT HUBS

A. Conduit hubs for use on raceway system pull and junction boxes shall be watertight, threaded aluminum, insulated throat, stainless steel grounding screw

B. Manufacturers

1. T&B H150GRA Series

2. Approved equal.

2.08 GROUNDING BUSHINGS

A. Grounding bushings shall be copper free aluminum, insulated lay-in lug grounding bushings with tin-plated copper grounding path. Bushings shall have integrally molded noncombustible phenolic insulated surfaces rated 150°C. Each bushing shall be furnished with a plastic insert cap. The size of the lug shall be sufficient to accommodate the maximum ground wire size required by the NEC for the application.

B. Manufacturers

1. O-Z/Gedney Type ABLG

2. Approved equal.

2.09 RACEWAY SEALANT

A. Raceway sealant for use in the sealing of raceway hubs, entering or terminating in boxes or enclosures where such sealing is shown or specified, shall be 3M 1000NS Watertight Sealant, or approved equal.

B. For cable bundles up to seven cables, in a duct entering a building, use Tyco RDSS Duct Sealing Product. For cable bundles of more than seven cables, in a duct entering a building, use 3M 1000NS Watertight Sealant.

2.10 CONDUIT PENETRATION SEALS

A. Conduit wall and floor seals

1. O.Z./Gedney Co. Series CSM

a. Type CSML-XXXP shall be used for all applications that do not require a recessed sealing bushing.

b. Type CSMI-XXXP shall be used for all applications that require a recessed sealing bushing.

c. Approved equal.

2.11 EXPANSION-DEFLECTION COUPLING

A. Combination expansion-deflection fittings with 3/4-inch axial expansion and contraction movement, 3/4-inch parallel misalignment movement, and up to 30 degrees of angular movement in any direction. It shall be copper-free aluminum, with exterior tinned copper braid bonding jumper and 316 stainless grounding straps

B. Manufacturers

1. Eaton Model XD

2. Approved equal.

C. Provide an aluminum cover over the fitting to protect the rubber portions from exposure to direct sun light. Secure the aluminum sun shield with a minim of two stainless steel tie wraps. See detail on the rawings

D. Nylon tie wraps are not acceptable.

2.12 EXPANSION FITTINGS

A. Expansion fittings shall provide eight-inch movement, shall be made of copper-free aluminum, with exterior tinned copper braid bonding jumper and 316 stainless grounding straps. Provide internal grounding. Nylon tie wraps are not acceptable.

B. Manufacturers

1. Eaton Type XJGSA

2. Approved equal.

2.13 EXPLOSION-PROOF SEALS, BREATHERS AND DRAINS

A. Explosion proof fittings shall be designed for Class 1 Division 1, Group D, hazardous locations. Fittings shall be copper-free aluminum, with seals, breathers and drains. Provide type ED, or as required for the application.

B. Manufacturers

1. Eaton

2. Appleton Electric Co.

3. O.Z./Gedney Co.

4. Approved equal.

2.14 KELLEMS GRIPS

A. Kellems grips cables supports shall be 316 stainless steel.

2.15 CONDUIT MOUNTING EQUIPMENT

A. Pull and junction box supports, spacers, conduit support rods, clamps, hangers, channel, nut, bolts, washers, etc. and shall be 316 stainless steel. Nylon tie wraps are not acceptable.

2.16 CONDUIT IDENTIFICATION TAGGING

A. Tag all underground conduits at all locations exiting and entering from underground, including manholes and handholes.

B. Use the tagging formats for conduits as shown on the drawings.

C. Use the tagging formats for conduits as shown on the drawings. Where modifications or additions are made to existing equipment replace existing tags with new modified tags.

D. Conduit identification plates shall be embossed stainless steel with stainless steel band, permanently secured to the conduit without screws. Nylon tie wraps are not acceptable.

E. Identification plates shall be as manufactured by the Panduit Corp. [no equal] [or equal].

PART 3 EXECUTION

3.01 RACEWAY APPLICATIONS

A. Unless exact locations are shown on the Drawings, coordinate the placement of raceway systems and related components with other trades and existing installations.

B. Raceway Systems for the installation of Fiber Optic Cables shall not contain conduit bodies, device boxes, or raceway boxes containing less than twelve inches of bend radius.

C. Unless shown on the Drawings or specified otherwise, the raceway type installed with respect to the location shall be as follows, including all materials:

Raceway System	Location
1. PVC Coated Aluminum (CRMC) Type	All embedded raceway bends, underground duct bank bends of more than 20 degrees, and all raceway stub-ups to a minimum of six inches above finished floor or grade and in Chlorine and Caustic rooms.
2. Liquid tight Flexible Aluminum (LFMC) Type	Raceway connection to vibrating equipment, and as shown on the Drawings in all areas.
3. Rigid Non-metallic, Schedule 80 PVC (RNC) Type	Underground encased in red dyed reinforced concrete.
4. Rigid Non-metallic, Schedule 80 PVC (RNC) Type	For use only in Chlorine and Caustic Rooms.
5. Flexible Aluminum (FMC) Type	Fixture whip connection to lighting fixtures in NEMA 12 areas (maximum 3-feet). BX or AC type prefabricated cables are not permitted.
6. Aluminum Rigid Metal (RMC) Type	All above grade areas, except for concrete embedded and those areas described in Locations 2 through 6 above.

D. All conduit of a given type shall be the product of one manufacturer.

3.02 BOX APPLICATIONS

A. All raceway junction boxes, pull and terminal boxes and electrical equipment enclosures shall have NEMA ratings for the location in which they are installed, and as specified herein.

B. The distance between each raceway entry inside the box and the opposite wall of the box shall not be less than eight times the metric designator (trade size) of the largest raceway in a row. This distance shall be increased for additional entries by the amount of the sum of the diameters of all other raceway entries in the same row on the same wall of the box. Each row shall be calculated individually, and the single row that provides the maximum distance shall be used.

C. Provide cast aluminum conduit fittings for exposed switch, receptacle and lighting outlet boxes.

D. All raceway boxes and wall – mounted electrical equipment enclosures shall be provided with factory mounting integral welded mounting lugs. Bolt-on gasketed mounting lugs attached through factory-drilled holes are not acceptable for any raceway box or electrical equipment enclosure. Drilling through the back of any box or enclosure is prohibited, and if so installed, shall be removed, and replaced, with no increase in the Contract Price or Construction Schedule.

E. No penetrations shall be made in the top of boxes or electrical equipment enclosures in wet locations.

F. Boxes for use only on concealed, above ground, interior electrical wiring, in air-conditioned administrative buildings remote to the process area, may be NEMA 1 galvanized boxes as specified for such areas. All boxes used in such areas, for exposed wiring, shall be NEMA 12 aluminum or 316 stainless steel as specified above.

3.03 DEVICE BOX APPLICATIONS

A. Device boxes shall be used for mounting wiring devices such as receptacles, switches, thermostats, lighting, and other permanently mounted devices. All device boxes shall be installed with a minimum of 1/4-inch air space between the back of the box and the wall or back panel on which it is installed. The space may be created with enough 316 stainless steel washers to provide the required air space or may be mounted using 316 stainless steel slotted channel.

3.04 CONDUIT OUTLET BODIES APPLICATIONS

A. Conduit outlet bodies may be used on conduits up to and including 2-1/2 inches, except where junction boxes are shown or otherwise specified. For conduits larger than 2-1/2 inches, junction boxes shall be provided.

3.05 CONDUIT HUB APPLICATIONS

A. Unless specifically stated herein or described on the Drawings, all raceways shall terminate at an outlet with a conduit hub. Locknut or double locknut terminations will not be permitted.

B. When conduits contain equipment grounding conductors the wire shall be grounded to the hub(s) associated with that grounding conductor.

3.06 INSULATED GROUNDING BUSHING APPLICATIONS

A. Insulated grounding bushings shall be provided and used to terminate raceways where the raceways enter pad-mounted electrical equipment or switchgear from the bottom where there is no wall or floor pan on which to anchor or terminate the raceway.

B. All other raceways shall terminate on enclosures with a conduit hub, except for NEMA 7/4X areas.

C. Grounding bushing caps shall remain on the bushing until the wire is ready to be pulled.

3.07 CONDUIT FITTINGS APPLICATIONS

A. Combination expansion-deflection fittings shall be installed where conduits cross structure expansion joints and installed in exposed conduit runs such that the distance between expansion-deflection fittings does not exceed 150 feet of conduit run. Expansion-deflection fittings are acceptable in indoor locations out of exposure to direct sunlight or other outdoor locations which are shaded.

B. Combination expansion-deflection fittings are not acceptable for use outdoors unless approved in writing on a case-by-case basis from the Engineer/Owner. Where combination expansion-deflection fittings with exposed non-metallic sections, are approved by the Engineer/Owner for use where exposed to sunlight or other outdoor locations which are shaded, an aluminum wrap shall be installed loosely over the non-metallic portion, extending at least two inches beyond the ends. The wrap shall be loosely secured, to permit movement, with at least two 316 SS fasteners. Nylon tie-wraps are not acceptable.

C. Provide an expansion fitting with a minimum of six inches available movement shall be installed on the exposed side of under to above grade conduit transitions. Expansion-deflection fittings shall not be provided unless approved and protected as specified above.

3.08 CONDUIT PENETRATION SEALS APPLICATIONS

A. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the Drawings.

B. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

3.09 EXPLOSION-PROOF SEALS, BREATHERS AND DRAINS APPLICATIONS

A. Fittings consisting of sealing fittings, breathers, drains, with sealing compound and fiber, as specified herein, shall be used as required to meet all the requirements of the National Electrical Code.

3.10 CONDUIT TAG APPLICATIONS

A. All conduits shall be tagged within one foot of the entry of equipment, and wall and floor penetrations.

B. Tag all underground conduits and ducts at all locations, exiting and entering from underground, including manholes and handholes.

3.11 RACEWAY SEALING

A. All raceways entering junction boxes, terminal junction boxes, electrical equipment enclosures or control panels containing electrical, or instrumentation equipment shall be connected to the box, enclosure or panel using conduit hubs and shall be sealed with Raceway Sealant, as specified herein.

3.12 PVC RACEWAY TO PVC COATED ALUMINUM RACEWAY TRANSITIONS IN CONCRETE ENCASEMENT

A. Transitions from PVC raceway to PVC coated aluminum raceway in concrete encasements shall be made as follows:

1. Terminate the PVC conduit in a threaded PVC female adapter.

2. Terminate the PVC coated aluminum conduit in a threaded male adaptor.

3. Thread the male PVC-coated aluminum conduit adaptor into the female threaded PVC adapter.

B. Tighten the joint securely, then double layer wrap the joint with two-inch vinyl electrical tape for two inches each side of the threaded joint to prevent any contact between any exposed aluminum threads and concrete.

3.13 RACEWAY INSTALLATION

A. Do not install pull wires and conductors until the raceway system is in place. No wire shall be installed between outlet points, junction points or splicing points, until all raceway sections are complete, and all raceway covers are installed for protection of conductors from damage or exposure to the elements. Conductors installed into incomplete raceway systems are considered improperly installed and are in violation of the NEC. The occurrence of wire installed in an incomplete installation, shall require the removal of such conductors from the project site, and replacement of the conductors at with no increase in Contract Price or Schedule. The raceway system shall be completed and inspected by the Engineer/Owner before new conductors are installed.

B. No conduit smaller than 3/4-inch electrical trade size, shall be used, nor shall any have more than the equivalent of three 90-degree bends in any one run. Pull boxes shall be provided as necessary. Conduit reducers which are the same type of the raceway shall be installed where manufacturer-provided enclosures are not available with conduit hubs larger than 1/2-inch at the enclosure to terminate 3/4-inch conduit. The raceway fill shall be adjusted to accommodate the smaller opening in the manufacturer-provided enclosure. Notify the Engineer/Owner prior to the installation of the raceway into enclosures with openings smaller than the specified minimum. Raceways installed without notice are considered unacceptable and may be required to be removed at the Engineer's/Owner's discretion with no increase in the Contract Price or Schedule allowed.

C. All raceways, installed underground, shall be installed in accordance with Section 26 05 43 Underground System, and be a minimum size of two-inch trade size unless otherwise shown in the plans.

D. Raceways entering or leaving the raceway system, which could be subjected to the entry of moisture, rain, or liquid of any type, shall be tightly sealed, using 3M 1000NS Watertight Sealant, or approved equal at any possible moisture entry point both before and after the installation of cables to prevent the entry of water or moisture to the Raceway System at any time. Any damage to new or existing equipment, due to the entrance of moisture from unsealed raceways, shall be corrected by complete replacement of such equipment. No increase in the Contract Price or Schedule will be allowed. Cleaning or drying of such damaged equipment will not be acceptable.

E. Conduit supports, other than for underground raceways, shall be spaced at intervals of eight feet or less, as required by the NEC and as required to obtain rigid construction. Conduits shall be supported near the entry into any enclosure in accordance with the NEC. Conduits shall not be used to support other conduits, nor shall conduits be supported from cable tray.

F. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface.

G. Multiple runs of conduits shall be supported on trapeze type hangers with horizontal members and threaded hanger rods. The rods shall be not less than 3/8-inch diameter. Multiple conduits mounted on walls shall be supported using strut and 316 stainless steel conduit clamps, screws, nuts and washers.

H. Surface mounted panel boxes, junction boxes, conduit, etc. shall be supported as specified herein.

I. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, anchors shall be as specified in Section 16045 Electrical Support Hardware.

J. No electrical equipment enclosures, boxes, terminal junction boxes or raceways shall be attached to or supported from, sheet metal walls.

K. All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. Offsets in conduit runs shall all be done at the same point and shall all be the same angle, so the entire installation appears to be parallel or concentric at every point. All conduits shall be run perfectly straight and true.

L. Conduits terminated into enclosures shall be perpendicular to the walls where flexible liquid tight or rigid conduits are required. The use of short seal tight elbow fittings for such terminations will not be permitted, except for connections to instrumentation transmitters, where multiple penetrations are required.

M. Conduits containing equipment grounding conductors and terminating in boxes shall have insulated throat grounding bushings. The grounding conductor shall be grounded to the box.

N. Conduits shall be installed using threaded fittings. Running threads will not be permitted.

O. Provide glued type conduit fittings on PVC conduit.

P. Conduits installed which are not in compliance with these requirements shall be removed and reinstalled at the Engineer's/Owner's discretion. If conductors are installed when the improper installation is discovered, the conductors shall be removed from the raceway, discarded, and removed them from the job site, replaced, re-terminated, retagged, and retested in accordance with the specifications. The function of the system shall be retested in its entirety. No increase in Contract Time or Schedule will be allowed.

Q. Liquid tight flexible metallic conduit shall be used for the primary and secondary of transformers, generator terminations and other equipment where vibration is present. Use in other locations is not permitted, except for connections to instrumentation transmitters, where multiple penetrations are required. Liquid tight flexible metallic conduit shall have a maximum length not greater than that of a factory manufactured elbow of the conduit size being used. The maximum bending radius shall not be less than that shown in the NEC Chapter 9, Table 2, "Other Bends". BX or AC type prefabricated cables will not be permitted.

R. Seal the remaining openings or spaces of conduits passing through openings in walls or floor slabs to prevent the passage of flame or smoke where additional openings or space around the conduits are present.

S. Conduit ends exposed to the weather or corrosive gases shall be sealed with conduit sealing bushings.

T. Raceways terminating in Control Panels or enclosures outdoors or any wet or damp location or any location where plant process equipment is located, or any location not otherwise specifically designated as a dry electrical room, control room or office space, which contain electrical equipment or terminal blocks, shall not enter from the top of the enclosure. The raceways shall be sealed with a watertight sealant as specified herein. Enclosures entered from the top where top entry is prohibited, will be rejected, and shall be removed and replaced regardless of the Division which contains the specification for the enclosure. The use of UL Listed conduit closures to restore the NEMA rating of the enclosure will not be accepted. Conduit entering the top of the enclosures shall be removed and re-routed to enter the enclosure from the side or bottom. Conductors installed in top entering conduits shall be pulled back to the nearest conduit body or junction box and re-routed with the conduit, provided the conductors are long enough to be re-terminated. Conductors found to be insufficient in length to be re-terminated shall be completely removed and replaced, re-tested, re-tagged, re-tested and the control function of the panel shall be re-tested. If the enclosure is provided by an OEM, the enclosure and its contents shall be returned to the OEM for a new enclosure. No increase in Contract Price nor increase in Contract Time will be allowed for making these corrections.

U. All conduits from external sources entering or leaving a multiple compartment enclosure shall be stubbed up into the bottom horizontal wire way or other manufacturer designated area, directly below the vertical section in which the conductors are to be terminated. Conduits entering from cable tray shall be stubbed into the upper section.

V. Conduit sealing and drain fittings shall be installed in areas designated as NEMA 4X or 7 and all wet locations.

W. A conduit identification plate shall be installed on all power, instrumentation, alarm, and control conduits at each end of the run and at intermediate junction boxes, manholes, etc. Conduit plates shall be installed before conductors are pulled into conduits. Exact identification plate location shall be coordinated with the Owner/Engineer at the time of installation to provide uniformity of placement and ease of reading. Conduit numbers shall be exactly as shown on the Drawings.

X. Mandrels shall be pulled through all existing conduits that will be reused and through all new conduits two inches in diameter and larger prior to installing conductors.

Y. 3/16-inch polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment.

Z. All conduit that may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc. shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits at the point of attachment to the equipment.

AA. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.

BB. The use of running threads is prohibited. Where such threads are necessary, a three-piece union shall be used.

CC. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc. shall be sealed with Watertight Sealant as specified herein.

DD. Conduits shall be located a minimum of three inches from steam or hot water piping. Where crossings are unavoidable, the conduit shall be kept at least one inch from the covering of the pipe crossed.

EE. Conduits terminating at a cable tray shall be supported independently from the cable tray. Provide a conduit support within one foot of the cable tray. The weight of the conduit shall not bear on the cable tray.

FF. Conduits entering the top of electrical equipment enclosures from cable tray or otherwise routed from above the equipment in airconditioned dry indoor spaces shall coordinate their placement with the HVAC duct vents such that cold air from the HVAC system will not blow directly on the vertical conduits causing condensation. Conduits which cannot be located away from direct exposure to cold air from the HVAC system shall be insulated to prevent condensation from forming inside the conduits or shall be re-routed. In all cases, condensation caused by cold air from the HVAC system shall be prevented from entering electrical enclosures. Equipment damaged by water from condensation shall be removed, replaced, conductors re-terminated, and its operation retested with no change in the contract price or schedule.

GG. All changes of direction on PVC coated conduit greater than 20 degrees shall be accomplished using long radius bends. Any field bends shall be made using equipment designed to prevent damage to the PVC coating.

END OF SECTION

SECTION 26 05 36
CABLE TRAYS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install complete cable tray systems, with all accessories, fittings, supports, as indicated specified, and in accordance with the latest applicable NEMA and ASTM standards.

B. Cable tray runs outline the general routing of raceways. Select actual routing in the field to follow Drawings as closely as possible and to avoid interfering with pipes, ducts, structural members, or other equipment. Deviations in routing from that shown on the Drawings must be approved by the Engineer, at no additional cost to the Owner.

1.02 RELATED WORK

A. Submittals are included in Section 01 33 23.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01 33 23, the following:

1. Shop Drawings: Indicate tray type, dimensions, support points and finishes.

2. Product Data: Provide data for fittings and accessories.

3. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product.

1.04 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1. NFPA 70 - National Electric Code.

B. ASTM International

1. ASTM B633 SC1 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

C. National Electrical Manufacturers Association (NEMA)

1. NEMA VE-1 - Metallic Cable Tray Systems

D. Canadian Standards Association (CAN/CSA)

1. CAN/CSA C22.2 - No. 126-M91 Cable Tray Systems

E. Underwriters Laboratories (UL)

F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum of three documented experience.

1.06 REGULATORY REQUIREMENTS

A. Conform to the requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for the purpose specified herein and as shown on the Drawings.

1.07 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. T.J. Cope

B. B-Line

C. Chalfant

D. Omnitray

E. Or Approved Equal

2.02 LADDER-TYPE CABLE TRAY

A. Description: NEMA VE 1, Class 20C ladder type tray.

B. Material: Aluminum

C. Finish: ASTM A123, hot dipped galvanized after fabrication.

D. Inside Width: Power Tray: 30 in, Control Tray: 24 in, Communication tray: 6 in.

E. Inside Depth: 6 in

F. Straight Section Rung Spacing: 6 in on center.

G. Inside Radius of Fittings: 24 in.

H. Provide stainless steel clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors and grounding straps.

I. Covers: Flanged solid top cover.

2.03 WARNING SIGNS

A. Permanent warning label shall appear on all straight sections and fittings and shall have the following wording: WARNING! DO NOT USE CABLE TRAY AS A WALKWAY, LADDER OR SUPPORT. USE ONLY AS A MECHANICAL SUPPORT FOR CABLES AND TUBING.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install metallic cable tray in accordance with NEMA VE 1.

C. Install fiberglass cable tray in accordance with NEMA FG 1.

D. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 10-ft maximum.

E. Use expansion connectors where required.

F. Ground and bond cable tray under provisions of NEC Article 318.

1. Provide continuity between tray components.

2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.

3. Provide 2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each component.

G. Provide cable tray angle brackets and supports to keep cable tray from swaying or moving horizontally. Mount on each side every 30-ft.

END OF SECTION

SECTION 26 05 43
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install a complete underground system of raceways, manholes and handholes as shown on the Drawings and as specified herein.

B. Raceways for use in structural concrete is specified in Section 26 05 33 Raceways, Boxes and Fittings.

1.02 RELATED WORK

A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

B. Submit to the Engineer, shop drawings and product data, for the following:

1. Manholes, handholes and associated hardware.

2. Plastic duct spacers Calculated pulling tensions for each direction of pull as specified.

3. Submit the calculated pulling tensions to the Engineer for approval prior to beginning the installation.

4. Submit the recorded pulling tensions for each pull as specified.

C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will be returned unreviewed.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NFPA 70 – National Electrical Code (NEC)

2. NFPA 70E – Standard For Electrical Safety in the Workplace

3. ASTM A615/A615M-06a – Standard Specification for Deformed and Plain Carbon-Steel Bars for concrete Reinforcement

4. ASTM A48 – Standard Specification for Gray Iron Castings

5. ASTM A536 - Standard Specification for Ductile Iron Castings

6. AASHTO M306-04/ ASTM A48 – Drainage Structure Castings, Section 7.0 Proof Load Testing

7. ASTM C-850- Specifications for underground precast concrete utility structures

B. All excavation, trenching, and related sheeting, bracing, etc., as shown on the Drawings, and listed in these Specifications, shall comply with the following standards (unless otherwise noted):

1. Occupational Safety and Health Administration (OSHA)

   a. Excavation safety standards (29 CFR Part 1926.650 Subpart P) - Excavation.

2. American Society for Testing and Materials (ASTM)

   a. ASTM D 698a – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)).

C. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The precast manholes shall be manufactured in a NPCA (National Precast Concrete Association) Certified Plant.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.

B. Materials shall be handled and stored in accordance with manufacturer's instructions.

C. Materials shall not be stored exposed to sunlight. Such materials shall be completely covered.

D. Materials showing signs of previous or jobsite exposure will be rejected.

1.07 WARRANTY

A. Provide warranties, including the manufacturer’s warranty, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner

1.08 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 MATERIALS

A. Raceway System

1. The criteria specified in Section 26 05 33 – Raceways and Boxes for Electrical Systems shall apply to this section.

2. Raceway system shall be Schedule 80 PVC Rigid Nonmetallic Conduit (RNC), designed for use aboveground and underground as described in the NEC, resistant to sunlight. The conduits and fittings shall be manufactured to NEMA TC-2, Federal Specification WC1094A and UL 651 specifications. Minimum raceway size shall be 2 inch. Fittings shall be manufactured to NEMA TC-3, Federal Specification WC1094A and UL 514B. Conduit shall have a UL Label. Conduit shall be Carlon, Kraloy, or approved equal.

3. PVC coated rigid aluminum conduit shall have a minimum 0.040-inch thick, polyvinyl chloride coating permanently bonded to rigid aluminum conduit and an internal chemically cured urethane or enamel coating. The ends of all couplings, fittings, etc. shall have a minimum of one pipe diameter in length of PVC overlap. PVC coated conduit and fittings shall be as manufactured by Perma-Cote, Robroy Industries, Calbond or Ocal, or approved equal. Any field bends shall be made using equipment designed to prevent damage to the PVC coating.

4. All underground raceways of the underground system, terminating in manholes or handholes shall use terminators of the same size and type as the raceway.

5. Blank Duct Plugs shall be sized for the duct installed on and shall be TYCO Type JM-BLA-XXDXXXCR, with rubber gasket, or approved equal.

6. Duct spacers shall be as manufactured by Carlon approved equal.

7. Raceways terminate into existing and new manholes, handholes or structures, shall have the duct bank steel anchored into the manhole, handhole or structure with a Hilti HIT 150 MAX epoxy anchoring system, approved equal. The termination of the duct bank steel shall utilize a minimum 24-inch length of reinforcing bar anchored not less than four inches into the manhole, handhole or structure wall, and lapped into each reinforcing bar in the duct bank.

8. Concrete encasement for raceways and duct banks shall be normal weight concrete weighing not more than 145 pounds per cubic foot with compressive strength, a minimum of 3000 pounds per square inch, or greater if required by other Divisions of the Specifications, at 28 days, Concrete shall have crushed aggregate with a maximum size of 3/4-inch, a slump of four to six inches and flow freely without the use of vibrators. Install red dye of 40 pounds per 10 cubic yards. of concrete, installed in the truck at the concrete plant.

9. Reinforcing steel shall comply with ASTM A615 Grade 60 and of a size and installation as shown on the Drawings.

B. Grounding

1. A ground rod shall be installed near to and outside each manhole or hand hole and the grounding conductor routed along with the duct bank shall be exothermically welded to the ground rod.

2. The duct bank grounding conductor shall not enter the manhole or hand hole.

C. Manholes and Handholes

1. General

a. Manholes and handholes shall be of the precast concrete type, designed for a Class H20 load with sizes as shown on the Drawings, and as manufactured by Oldcastle Precast, Mansfield, TX, approved equal.

2. Construction

a. Concrete for manholes and handholes shall have a 28-day compressive strength of 5000 PSI. Cement shall be Type 1 or III. Reinforcing steel shall be Grade 60 with minimum yield strength of 60,000 PSI. Design loadings shall be H-20-44 w/impact.

b. The top of all manholes shall be field removable and have stainless steel lifting eyes.

c. Duct bank entries into the manhole or handhole shall be centered on the entering wall unless otherwise shown or specified.

d. Cables shall be secured to racks along the walls such that cables are not routed below any access opening.

e. Manholes in medium voltage systems shall have the duct banks enter on the wall such that the routing and securing of the cables shall be made so that they do not pass under any access opening and the minimum bending radius of the cable is not less than allowed.

f. The duct bank entering the manhole shall contain the appropriate number and size of duct terminators to match the corresponding duct bank.

g. Each manhole and handhole shall have a minimum size of 1-inch\ by 12 inch by 2-inch-deep concrete sump in the middle of the floor of the manhole or handhole, or as shown on the Drawings.

3. Manhole Covers

a. Unless otherwise shown on the Drawings, manhole and handhole covers shall be heavy duty 36-inch machined gray iron, and AASHTO M306-04/ ASTM A48 CL35B Minimum, 40,000-pound proof load value (Class H20 X 2.5) “True Traffic” load covers, complete with frame, and “Electric” or “Communication” raised lettering recessed flush, as required, on the cover. Covers shall be V-1600-5, with drop handles as manufactured by East Jordan Iron Works, Ardmore, OK, or approved equal.

b. All castings shall be made in the USA, cast with the foundry’s name, part number, “Made in USA”, and production date (example: mm/dd/yyyy). Castings without proper markings will be rejected. Manufacturer shall certify that all castings conform to the ASTM and AASHTO Designations as specified herein. All casting shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting strength and value for the service intended. Angles shall be filleted and arises shall be sharp and true.

4. Access Hatch

a. Where access hatches are shown on the Drawings, hatches shall be heavy duty aluminum, for H-20 load rating, sized as shown on the Drawings. Hatches shall be CHS Series as manufactured by East Jordan Iron Works, Ardmore, OK or approved equal.

b. Material shall be 6061-T6 aluminum for bars, angle, and extrusions. 1/4-inch diamond plate shall be 5066 aluminum.

c. Unit shall have a heavy-duty pneumatic spring, for ease of operation when opening cover. Cover shall be counter-balanced so that one person can easily open the hatch door.

d. Frame shall be of extruded aluminum with a continuous 1-1/4-inch anchor flange. A dovetail groove shall be extruded into the seat of the frame with a 1/8" silicone gasket.

e. Hinges shall be of heavy-duty design, the material shall be grade 316 stainless steel, with a 3/8-inch grade 316 stainless steel pin. Hinge shall be bolted to the channel frame and diamond plate with grade 316 stainless steel bolts and nylon lock nuts. Aluminum shall be supplied with mill finish. Exterior of frame which contacts concrete shall have one coat black primer.

f. Each hatch shall be supplied with a stainless-steel slam lock, with the keyway protected by a threaded aluminum plug. The plug shall be flush with the top of the 1/4-inch diamond plate. The slam lock shall be fastened with grade 316 stainless steel bolts and washers.

g. Each hatch shall be equipped with a stainless-steel lift handle. Lift handles shall be flush with top of 1/4-inch diamond plate.

h. Each hatch shall be supplied with a 1-1/2-inch threaded drain coupler on underside of channel frame for pipe connection.

5. Hardware

a. Cable racks shall be of the heavy-duty non-metallic type with arm lengths of 8 inches, 14 inches, and 20 inches, each supporting a load of not less than 250 pounds at the outer end. Racks shall be molded in one piece of U.L. listed glass reinforced nylon, Catalog CR36N with RA08N, RA14N and RA20N arms as manufactured by Underground Devices Inc. Northbrook, IL or approved equal. Cable racks shall be secured to the manhole and walls by drilled, Hilti HIT-HY 150 MAX epoxy anchoring system, with Hilti 316 stainless steel bolts. Arms for racks shall be vertically spaced not greater than 24 inches on centers.

b. Pulling irons shall be of copolymer polypropylene coated 1/2-inch diameter cable, with a rated pulling strength of 7500 pounds and a polyethylene pulling iron pocket, all recessed in the manhole wall opposite each duct entry. Pulling irons for handholes shall have the pulling iron located in the floor of the handhole near the center of the handhole opposite the duct entry. Pulling irons shall be as manufactured by M.A. Industries, Inc. Peachtree, GA. or Bowco Industries, Portland OR or approved equal.

c. Manhole and handhole ladders shall be constructed of fiberglass reinforced plastic, safety yellow, 18-inch rung width with 12-inch rung spacing, Safrail as manufactured by Strongwell Corp., Bristol, VA or approved equal. Furnish a total of two ladders, each of a length four feet greater than the deepest manhole in the underground system.

D. Polyethylene Warning Tape

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

a. Brady Detectable Identoline

b. Approved Equal,

2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

3. Warning tape shall be metal detectable polyester with subsurface graphics, black letters on red tape. The tape shall meet the OSHA 1926.956(c)(1), two-inch minimum width, for location tracing.

PART 3 EXECUTION

3.01 GENERAL

A. Field verify the routing of all underground duct banks before placement. He shall modify the routing as necessary to avoid underground utilities or above ground objects. Modification or rerouting for convenience, or to reduce the length of duct run as designed, will not be permitted. Provide any alternate routing of the duct banks to the Owner/Engineer and, after approval, shall proceed with the installation.

B. All changes of direction, less than 20 degrees, shall be made using a hotbox, strictly in conformance with the conduit manufacturer's instructions. Changes of direction greater than 20 degrees shall be accomplished using long radius bends of PVC coated rigid aluminum conduit.

C. Saw cut and repair existing pavements above new and modified existing duct banks. Provide the alternate routing of the duct banks to the Owner/Engineer and after approval shall proceed with the installation.

D. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3 inches per 100 feet.

E. Reinforce raceway banks as shown on the Drawings.

F. A #4/0 stranded bare tinned copper ground conductor shall be installed along the top of the rebar cage, as shown on the Drawings, for the full length of each duct run between manholes and handholes and bonded to a ground rod in the vicinity of each manhole and handhole.

G. Lay raceway lines in trenches on compacted earth as specified herein.

H. Use plastic spacers located not more than four feet apart to hold raceways in place. Spacers shall provide not less than two-inch clearance between raceways.

I. Place 3-inch by 3-inch by 3-inch blocks under the duct bank at each spacer location to hold the duct bank and reinforcing rebars off the floor of the duct bank trench so the concrete envelope can surround the duct bank assembly.

J. The minimum cover for raceway banks shall be 24 inches unless otherwise permitted by the Owner/Engineer.

K. Raceway entering manholes both existing and new shall be terminated with bell end terminators installed flush with the manhole wall unless otherwise shown, specified, or approved by the Engineer.

L. Blank duct plugs shall be used to seal the ends of all unused ducts in the duct system. Plugs shall be installed at all locations where the ducts enter and leave the manholes or handholes, and all entrances and exits to the underground system.

M. Raceways entering or exiting the Underground System, and raceways rising to a higher elevation upon entering or leaving the System, shall be tightly sealed at the higher elevation, both before and after the installation of cables, T there shall be no entry of water or moisture to the Underground System at any time. Raceways shall be sealed with 3M 1000NS Watertight Sealant or approved equal.

N. No wire shall be pulled until the duct system has been completed in every detail.

O. Swab all raceways clean before installing cable.

P. Train cables in manholes and handholes and support and restrain them on cable racks. All cables passing manhole duct entrances in the manhole or handhole shall pass above all duct entrances. No cable shall pass in front of or below duct bank entrances.

1. The location of various conductors shown on duct bank cross section details are not to be taken latterly in all cased. Reorganization of the cables in the various duct bank ducts to different locations in the duct bank to facilitate bundling of the different types of cables as they pass through the manhole or hand hole to isolate analog and other low voltage signal cables from all other cables that carry AC voltages is permitted.

2. No cables shall pass under the access hatch or opening to the manhole or hand hole.

3. Ducts routing medium voltage cables entering manholes or handholes may be allowed to enter off center close to adjoining walls will be permitted to facilitate the routing and racking the cables through the manholes to avoid violating the allowed minimum bending radius.

4. Duct banks carrying low voltage cables larger than 350 kcmil, may also enter manholes or handholes off center to facilitate routing and racking.

Q. Polyethylene Warning Tape shall be installed in the trench above each raceway or duct bank and located at the elevations shown on the Drawings.

R. Tag all underground conduits at all locations, exiting and entering from underground, including manholes and handholes.

S. The minimum raceway size shall be 2-inch unless otherwise shown on the plans.

3.02 PULLING TENSIONS

A. Calculate the pulling tensions for each direction of pull for each of the cables in each duct prior to the installation of the conductors. Submit the calculations to the Engineer prior to starting the installation of the conductors.

B. All installations that are not done by hand which require mechanical pulling machines shall be monitored. The maximum pulling tension recorded for each pull shall be recorded and submitted to the Owner and Engineer for record.

C. Conductors or cables installed by machine for which no pulling tensions were submitted prior to beginning the installation or are installed by machine without the pulling tensions being recorded shall be removed and replaced with no change in the Contract Price or Schedule.

3.03 TRENCH EXCAVATION

A. The excavation shall extend to the width and depth as shown on the Drawings, or as specified, and shall provide suitable room for installing manholes, handholes, ducts and appurtenances.

B. Furnish and place all sheeting, bracing and supports.

C. Excavation shall include material of every description and of whatever substance encountered, regardless of the methods or equipment required to remove the material. Pavement shall be cut with a saw, wheel, or pneumatic chisel along straight lines before excavating.

D. Strip and stockpile topsoil from grassed areas crossed by trenches. Topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.

E. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected, as provided for in the Contract Documents.

F. Materials shall be excavated to the depth indicated on the Drawings and in widths sufficient for installing manholes and laying the ducts. Coordinate the trench width the Details shown on the Drawings. The bottom of the excavations shall be firm and dry in all respects acceptable to the Owner/Engineer. Trench width shall be a practical minimum, but not less than 6 inches greater on each side, than the total duct section arrangement, including reinforcing steel.

G. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of sub grade soils. The trench may be excavated by machinery to, or just below, the designated sub grade, if material remaining in the bottom of the trench is no more than slightly disturbed. Sub grade soils which become soft, lose or otherwise unsatisfactory because of inadequate excavation, dewatering or other construction methods, shall be removed and replaced by gravel fill, of aggregate as specified herein, as required by the Owner/Engineer with no change in the Contract Price or Scheduled allowed.

3.04 EXCAVATION BELOW GRADE AND REFILL

A. Regardless of the nature of unstable material encountered, or the groundwater conditions, trench and excavation drainage shall be complete and effective.

B. If deemed necessary by the Owner/Engineer, or as shown on the Drawings, pea gravel shall be added for duct bedding or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatsoever. All excavation shall be made in open trenches. Gravel used for this purpose, shall be aggregate, as specified that is no larger than one-half the minimum clear spacing between electrical ducts, and a maximum coarse aggregate size of 3/4-inch.

3.05 BACKFILLING

A. Remove from the excavation all materials which the Owner/Engineer may deem unsuitable for backfilling.

B. Backfilling shall not commence until, not less than 48 hours after placing of any concrete embedment, have lapsed.

C. Where the duct banks are laid in the yard, the remainder of the trench, after concrete encasement, shall be filled with common fill material, void of rock or other non-porous material, in layers not to exceed eight inches in loose measure and compacted to 90% standard Proctor density at optimum moisture content of +/- 4%. The backfill shall be mounded six inches above the existing grade or as directed by the Owner/Engineer. Where a grass, loam or gravel surface exists prior to excavations in the yard, it shall be removed, conserved, and replaced to the full original depth as part of the work under the duct items. In some areas, it may be necessary to remove excess material during the cleanup process, so that the ground may be restored to its original level and condition.

D. Where the duct banks are laid in paved areas or designated future paved areas, existing or designated future structures, or other existing or future utilities, the remainder of the trench above the encasement, shall be backfilled with select common fill or select fill material in layers not to exceed eight inches loose measure and compacted at optimum moisture content (+/- 3%) to 95% standard Proctor density.

E. Compaction shall be by use of hand or pneumatic tamping with tools weighing at least 20 pounds. The material being spread and compacted shall be placed in layers not over eight inches loose thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.

F. Bituminous paving shall not be placed in backfill.

G. Water jetting will not be accepted as a means of consolidating or compacting backfill.

H. All road surfaces shall be broom finished and hose-cleaned immediately after backfilling. Dust control measures shall be always employed.

3.06 RESTORING TRENCH AND ADJACENT SURFACES

A. In paved areas, the edge of the existing pavement to be removed shall be cut along straight lines, and the pavement replaced with the same type and quality of the existing paving.

B. In sections where the duct bank passes through grassed areas, remove and replace the sod, or provide loam and reseed the surface to the satisfaction of the Owner/Engineer.

3.07 CLEANING

A. Remove all rubbish and debris from inside and around the underground system. Remove dirt, dust, or concrete spatter from the interior and exterior of manholes, handholes and structures, using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

END OF SECTION

SECTION 26 05 53
ELECTRICAL IDENTIFICATION

PART 1 G E N E R A L

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install a complete Electrical Identification System, as shown on the drawings and specified herein.

B. Specification as a minimum shall include for electrical identification including:

1. Nameplates and labels
2. Wire and cable markers
3. Conduit markers
4. Cable tray markers
5. Underground warning tape
6. Warning labels

1.02 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the manufacturers' names and product designation or catalog numbers of all materials specified.

B. Cut sheets for each individual item shall be submitted. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

C. Submit the following under the provisions of Division 01 and Section 26 05 01 Submittal Procedure:

1. Manufacturer's cut sheets and catalog data
2. Description of materials used
3. Label or nameplate dimensions

4. Engraving or imprint legends

5. Instruction for handling and storage

6. Installation instructions

1.03 REFERENCE CODES AND STANDARDS

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

1. No. 70 - National Electrical Code (NEC)

a) Article 110 - Requirements for Electrical Installation

b) Article 430 - Transformers and Transformer Vaults

B. City of Houston Building Code

C. Other applicable Codes and Standards as referenced in other Sections.

D. Underwriters Laboratories. U.L. Standards No. 224 - Extruded Insulated Tubing

1.04 JOB SITE DELIVERY, STORAGE AND HANDLING

A. Pack materials to permit ease of handling and to provide protection from damage during shipping, handling, and storage.

1.05 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

1.06 WARRANTY

A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Almetek Industries Incorporated

B. Brady U.S.A. Incorporated

C. Ideal Electric Company

D. Raychem Corporation

E. 3M Electrical Products Division

F. Thomas & Bett

G. HellermannTyton

2.02 MATERIALS AND EQUIPMENT

A. Nameplates and Labels

1. Provide an identification tag for each item of electrical and instrumentation equipment showing its item number and service or application. Use the description shown on the electrical Drawings.

2. For nameplates, use 3-ply phenolic material engraved to show black lettering on a white background. Size the nameplates approximately 1 inch wide and 3 inches long for 3 lines of 3/16 inch - 16 letters with a 0.8 condensed factor.

3. Generally, provide large pieces of equipment with engraved nameplates; provide additional nameplates at pushbuttons and other local devices; as detailed. Provide identification for all other electrical and instrumentation equipment, devices, or enclosures, such as MCC's, panelboards, disconnect switches, capacitors, relays, and dedicated receptacles not furnished with readily noticeable tag, nameplates, or other means of identification. Provide fault current nameplate per NEC requirements.

4. Install nameplates on the front cover of transformers stating the transformer service location number or identification number, the panelboard or device served, and main breaker feeding the transformer (MCC No. and compartment), and the drawing number on which the transformer schematic is shown.

5. Furnish equipment, such as motor starters, safety switches, welding receptacles and circuit breakers, with 1" x 3" plastic nameplates stating description of item served.

6. Provide nameplates for motors giving the driven equipment description, the service location number, and the MCC number with compartment number when applicable. Nameplates will normally be mounted adjacent to the motor at the motor pushbutton when one is furnished.

7. Install nameplates on the outside and inside of doors to circuit breaker panelboards

(i.e., lighting, instrument or receptacle panels). State the panelboard name, the drawing number on which the panelboard schedule shows, and the main breaker feeding the panel (MCC No. and compartment).

8. Type panelboard directories and insert them inside the panelboard doors. Text shall be 12pt- Arial font.

9. Place a large nameplate no less than 3"x5" on control panels, relay panels, junction boxes, or enclosures with electrical devices mounted inside or on the outside of the enclosure indicating the purpose of the cabinet.

10. Provide a nameplate on MCC motor starter doors duplicating motor nameplate data.

B. Wire and Cable Markers

1. Use pre-printed tubular heat-shrink type wire and cable markers at each end of all conductors.

2. Select markers manufactured so that the heat-shrink process makes the imprint permanent and solvent-resistant.

3. Use markers that are self-extinguishing, conforming to U.L. Standard No. 224 for print performance, heat shock, and flammability.

4. Provide marker material that is flexible, radiation cross-linked polyolefin with 3 to 1 shrink ratio, rated 600 volts, and white in color.

C. Conduit Markers

1. Provide conduit markers made of stainless steel tags approximately 2 inches x 1 inch x 19 gage.

2. Stamp the caption on the tag and have it black filled.

3. Punch tags for tie fasteners. Fasten tags to the conduits with stainless steel braided wire.

D. Cable Tray Markers

1. For high visibility and contrast, use cable tray markers that are yellow with black legend.

2. Use markers made of vinyl impregnated cloth, suitable for exposure to corrosive, wet, and abrasive environments.

3. Make markers of pre-cut individual letters or numbers with pressure sensitive adhesive backing.

4. Size legend characters to 4 inches high on a total marker height of approximately 5 inches, suitable for applying to 6-inch side rails of a cable tray.

E. Underground Warning Tape

1. Provide warning tape made of 4 mil thick polyolefin film, 3 inches wide, suitable for direct burial and resistant to alkalis, acids, and other common soil substances.

2. Use red tape with black legend printed in permanent ink.

F. Warning Labels

1. Place OSHA safety labels on enclosures and boxes 100 cubic inches or more containing electrical equipment or terminations.

2. Provide OSHA color codes for the labels. Use labels made from 4 mil vinyl with pressure sensitive adhesive backing.

3. The warning label caption is DANGER - 480 VOLTS or as indicated on the drawings

4. Size labels either 5 inches x 3-1/2 inches or 10 inches x 7 inches, as indicated on the Drawings.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Degrease and clean surfaces where adhesive labels will be applied.

B. Drill holes for nameplates to be fastened with stainless screws.

C. Prepare the cable ends for termination and conductor markings.

D. Identify conduits at terminating points and select tags accordingly.

3.02 INSTALLATION

A. Install nameplates and labels in accordance with the manufacturer's instructions and the Drawings.

B. Apply wire and cable markers in accordance with manufacturer's instructions using a heat gun with properly sized nozzle for the application. Tag the wires at both ends with the same notation.

C. Tag conduits at junction boxes, pull boxes, and at other termination points.

D. Identify cable trays at the time of installation with the alphanumeric number shown on the Drawings. Label cable trays on the outside rail. Place the tray identifier at each point where the tray designation changes and at 200 foot intervals in between, but not less than two per run.

E. Identify underground conduits, cables, or duct banks using the underground warning tape. The underground grounding grid, including the laterals. Also use underground warning tape. Install one tape per trench at 12 inches below grade or as indicated on the Drawings. For wide trenches or duct banks, install one warning tape per 24 inch width.

F. Apply the 5 inches by 3-1/2 inches warning labels to disconnect switches, panelboards, terminal boxes, and similar devices in accordance with manufacturer's instruction and the Drawings. Apply the 10 inches x 7 inches warning labels to larger control panel enclosures, motor control centers, and to entrance doors to buildings containing electrical power and control equipment.

END OF SECTION

SECTION 26 05 74
POWER SYSTEM STUDY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide a Power System Study for the electrical power system, including a Short Circuit Study, Coordination Study, Arc Flash Hazard Study, and additional studies as listed below.

B. The electrical power system shall include the utility company's transformer, the Owner's entire power distribution system, all existing and/or new system components, including any on-site standby generation. The short circuit and coordination study reports shall provide an evaluation of the electrical power systems and the model numbers and settings of the protective relays or devices and metering or motor monitoring devices for setting by the Contractor. The Study shall include settings for all motor protective relays and electric system monitoring devices.

C. The Study shall model all electrical equipment down to and including 480-Volt utilization equipment.

D. Motor Starting Voltage Drop Study: The Study shall include all motors modeled individually, including disconnect switches, if present.

E. Obtain and provide all pertinent data necessary for the successful completion of the Power System Studies, including information on all existing and/or new equipment and wiring pertinent to the Study. This includes all cable and raceway data, data for existing and/or new motors, data from all existing and/or new switchgear, motor control centers, panel boards, and separately mounted fuses, starters, and circuit breakers. Obtain all existing or new protective device information to include all present settings. Obtain any needed data or information from Contract Documents, various suppliers, the Electric Utility and from conducting his own field investigations. If during field investigations conflicts between the Contract Documents and the field conditions are encountered, immediately notify the Owner/Engineer for a resolution to the conflict. Copies of the data obtained, shall be organized, and submitted to the Owner/Engineer at the same time of transmittal to the Study Engineer, to show that all the requested data gathering work has been completed.

1.02 RELATED WORK

A. Refer to Division 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

B. Provide all the information required, to the Study Engineer in a timely manner.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, shall be made in accordance with Division 1 and Section 26 05 01 the following:

1. No later than four weeks after Contract Award, provide a submittal of the name and qualifications of the Study Engineer, for approval.

2. No submittals required under this section will be accepted until this requirement is met, and if submitted will be returned without review.

B. Provide the following additional submittals:

1. Preliminary Study: The first submittal shall consist only of the Short Circuit Study results and equipment evaluation, based upon sound engineering reasonable assumptions, where known values are not available. This submittal shall be used by the Study Engineer to ascertain the short circuit current rating of the related equipment. This submittal shall be made and approved prior to any shop drawing submittal being reviewed for electrical equipment for which the results of this preliminary study are required. The submittal and approval of the Preliminary Study is a critical milestone in the Construction Schedule. Failure to submit an acceptable study in a timely manner may delay the Project Schedule. No exceptions will be made for the specified sequence of the submittal of the Study prior to the submittal of shop drawings, and any delays caused by a late submittal of the Study will not be a cause for the Engineer / Owner to allow any extension of the Contract Time or Contract Price.

2. Final Study: The final submittal shall be the Final Study and shall include all items listed under "Scope of Work" in this Section. No electrical equipment for which the results of the final study are required, shall be energized until such results have been reviewed and approved by the Engineer / Owner, and applied to such electrical equipment, and certified as Settings Complete by the manufacturer's field representative. This submittal is required to include a PDF of the study and a copy of the SKM raw data input files as specified in Section 26 05 01.

C. Upon completion of the studies, submit the studies for approval to the Owner/Engineer. The study submittal shall include all the input and output data files in electronic format for use directly with the specified study software. The Study shall include an actual size sample of an Arc Flash and Shock Hazard label with typical information shown. Allow not less than three calendar weeks for review of the both the Preliminary and Final Studies by the Owner/Engineer. The submittal shall not contain unresolved questions, conflicts, or selective device coordination conflicts. A submittal containing such questions or conflicts will be returned unreviewed and shall not be resubmitted until such questions or conflicts have been resolved. Delays in the Construction Schedule due to the submittal of unacceptable Power System Studies will not be a cause for the Engineer / Owner to approve any changes in the Contract Time or Contract Price.

D. The completed, sealed, and signed studies, with all known issues resolved, shall be submitted to the Owner/Engineer for approval, not less than 30 days prior to site delivery of any equipment containing protective devices requiring selections and settings for certification by the manufacturer. Final copies shall be in electronic form (Adobe PDF formatted files). SKM data files, including any custom forms, labels, formats, and libraries, shall be provided at the same time in electronic format as specified herein. All individual arc flash labels, ready for installation, shall be provided with this submittal.

E. Submit for approval, a manufacturer's conducted training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual

1.04 REFERENCE CODES AND STANDARDS

A. The specified studies shall be in accordance with the latest versions of the following codes and standards.

1. IEEE Standard 1584 – IEEE Guide for Performing Arc-Flash Hazard Calculations, Including Amendment 1584a.

2. NFPA-70E - Standard for Electrical Safety Requirements for Employee Workplaces.

3. ANSI/NFPA 70 – National Electrical Code

B. The studies shall be performed using SKM Power Tools Electrical Engineering Analysis Software for Windows.

1.05 QUALITY ASSURANCE

A. The studies shall be performed by an Electrical Engineering Services firm, who is regularly engaged in power system studies. The studies shall be performed by a Licensed Professional Electrical Engineer (PE) in the regular employment of the firm with proficiency in electrical power systems engineering and shall seal and sign the final completed power system studies. The Study Engineer shall be licensed to practice engineering in the State of Texas.

B. The PE shall comply with the State PE Law in the submittal of the Preliminary and Final Studies. The Preliminary Study shall bear the name and registration number of the PE who will be sealing the work along with the statement acceptable to the State PE Board which indicates the work is "Preliminary, Not for Construction" and is "Issued for Review". The final report shall bear the Engineer's Seal, Registration Number, Original Signature and Date in accordance with the State PE Laws.

C. Computer Model Revision Control

1. The Study Engineer shall check out and receive from the Owner, prior to executing the Study, the base model computer file to be used with the SKM System Analysis computer program. The Study Engineer shall be responsible for the return of this computer file to Owner upon completion of the Study and acceptance of the Report by the Owner/Engineer. Field verify all existing protective equipment, protective device settings and conductors shown in the model which are in series with the new equipment all the way from the Utility and or Generator power sources to the connection point of the new equipment. Field verify the name plate data on all existing motors connected to the same bus or any upstream bus which is in series with the new equipment. The same criterion applies to all existing equipment modified under this Contract. Notify the Owner/Engineer of any discrepancies discovered which exist between the Owner's power system model and existing field conditions prior to the submittal of any Studies for review.

2. The Study Engineer shall incorporate the Study conducted for this Contract into the overall base model computer file. The updated file shall be returned to the Engineer for review along with the Report Submittal. It is unacceptable to add the branches of the new equipment provided under this Contract in a stand-alone or separated configuration from the overall power system and adding in the available fault current at the point of attachment. All revisions and the addition of all new equipment shall be tied into the existing power system model by the Study Engineer.

3. The Study Engineer shall forward the updated base model computer files to the Owner with the submittal of the Preliminary Study for the Engineer to check, and again the final model shall be submitted upon approval of the Final Report Submittal. This shall constitute checking this file back in to the Owner. Should the Report Submittal be rejected for any reason, the base model computer file shall be checked out again and returned to the Study Engineer for further use.

1.06 SCHEDULE OF WORK

A. The selection of the Study Engineer shall be submitted to the Owner/Engineer for approval in a timely manner, in accordance with the time specified. The Study shall be completed and submitted in the phases as specified above.

B. The completed studies, with all known issues resolved, shall be submitted to the Owner/Engineer for approval, as specified above.

1.07 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 STUDIES

2.01 ELECTRICAL ENGINEERING SERVICES FIRMS

A. The work experience resume of the Study Engineers who will be doing the work and the Professional Engineer who will be sealing the Final Study shall be submitted along with his / her PE registration number in the State where the equipment is to be installed. Subject to compliance with the Contract Documents, the following services firms are acceptable:

1. Eaton Engineering Services

2. ABB Engineering Services

3. Schneider Electric Engineering Services

4. Rockwell Automation Engineering Services

5. Approved equal.

2.02 SHORT CIRCUIT AND COORDINATION STUDY

A. Provide a complete short circuit study. Include three phase, phase-to-ground calculations, and X/R ratios. Provide an equipment interrupting or withstand evaluation based on the actual equipment and model numbers provided on this project including any existing equipment modified in any way under this project. Field verify the name plate data of all existing transformers, protective device equipment and the size and length of any existing conductors in series with the new or modified equipment in the Contract. Conductor lengths in concealed conduit shall be estimated to the best of the Contractor's ability from field observations and any available existing conformed to construction record drawings. Generic devices or values are not acceptable. Normal system operating method, alternate operation, and operations that could result in maximum fault conditions, shall be thoroughly addressed in the study. Provide single phase to ground and three-phase to ground fault information. The study shall assume all motors are operating at rated voltage with the exception that motors, clearly identified as "standby," shall not be included. Electrical equipment bus impedances shall be assumed as zero. Short circuit momentary duties and interrupting duties shall be calculated based on maximum available fault current at the switchgear busses, switchboard busses, motor control centers and panelboards. The study shall be performed using actual available short circuit currents as obtained from the Electric Utility. An assumption of infinite bus for the purposes of the Preliminary or Final study is not acceptable.

B. Provide an equipment evaluation study to determine the adequacy of the fault bracing of all bus from the panel board level up to the main switchgear or protective device. Include circuit breakers, controllers, surge arresters, busway, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents.

C. Provide a protective device coordination study. The study shall include all electrical equipment provided under this Contract, including Control Panels containing power and protection equipment lighting panels and power panels. The Study shall include any upstream or downstream equipment that has an impact on the Coordination Study. The study shall show transformer damage curves, cable short circuit-withstand curves and motor starting curves. The phase overcurrent and ground fault protection shall be included, as well as settings for all other adjustable protective devices. All motor monitoring relays and protective or monitoring devices that are a part of a supplier's equipment, such as soft starters or adjustable frequency drives shall be included. Include the last protective device in the Electric Utilities' system feeding each facility being considered. Include all medium voltage switchgear, distribution switchboards, motor control centers and 480 Volt panelboard main circuit breakers. Complete the short circuit study down to the main breaker or largest feeder on all on all 480 Volt panelboards. Panelboard branch circuit devices need not be considered. The phase overcurrent and ground-fault protection shall be included, as well as settings for all other adjustable protective devices. All motor monitoring relays and protective or monitoring devices that are a part of a supplier's equipment, such as soft starters or adjustable frequency drives, shall be included. Include the last protective device in the Electric Utilities system feeding each facility being considered.

D. Selective device coordination is required between protective devices in equipment specified in each Section of the Electrical Specifications, and between each piece of electrical equipment supplied for this project. Include settings for the protective devices in existing equipment feeding any piece of new equipment. If the Study Engineer, during his work, determines that selective coordination cannot be obtained in or between pieces of existing and/or new equipment as specified, the Owner/Engineer shall immediately be notified, Provide the supporting information to the Owner/Engineer for resolution of the problem.

E. Projects executed in phases may not have the new equipment provided under earlier phases on site when this study is being done. Obtain the shop drawings from the Owner for that equipment and include that data in this study. Obtain study data done by the Study Engineer doing any studies under previous phases and include that data in this study. Clearly indicate what information was obtained from the Owner. This is acceptable only for the preliminary phases of this study. The final study shall include actual information on equipment provided under the earlier phases, including fault studies and protective device coordination.

F. As a minimum, each short circuit study shall include the following:

1. One-Line Diagram: The presentation of the One Line Diagram shall be on one or more 22 x 34-inch drawings with match lines if on multiple sheets, using font sizes which are easily readable. Include the following information and activities listed below:

    a. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.

    b. Type designation, current rating, range or adjustment, manufacturer's style and catalog number for all protective devices.

    c. Power and voltage ratings, impedance, primary and secondary connections (Delta, Wye, Grounded Wye, Zig-Zag, etc.) of all transformers. Use the ratings of the actual transformers being provided where available. The Final Study shall use the name plate information on the transformers provided. Use the actual name plate information on all existing transformers. Generic transformer data on new or existing transformers are not acceptable.

    d. The type, manufacturer, and ratio of all instrument transformers energizing each relay shall be included on both existing and/or new instrument transformers. Field verify this information on all existing protective devices which are in series with the new equipment provided under this Contract.

    e. Nameplate ratings of all motors and generators with their sub transient reactance. Field verify the name plate information of all existing generator providing power to the new equipment, and field verify the name plate motor information on all motors connected to the bus of existing equipment which is in series with the new equipment.

f. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors. Provide short circuit studies using each source of power separately. The study shall determine if there is sufficient short circuit current to adequately cause interruption of a protective device using the weaker power source (typically local generation) and shall determine if the equipment can safely interrupt the fault if the greater power source is connected. Additional short circuit calculations shall include emergency as well as normal switching conditions as well as normal and emergency power sources described here in.

g. All significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc. shall be included.

h. The time-current setting of existing adjustable relays and direct-acting trips, if applicable. Field verify the information as specified herein.

i. Arrange for the shutdown of the equipment requiring field verification with the Owner, Investigations shall be done at a time, including after hours if necessary, which do not significantly interrupt the Owner's process operations.

2. Impedance Diagram: The presentation of the Impedance Diagram shall be on one or more 22 x 34-inch drawings with match lines if on multiple sheets, using font sizes which are easily readable. Include the following:

a. Available fault current or impedance from the utility company.

b. Local generated capacity impedance.

c. Transformer and/or reactor impedances.

d. Cable impedances.

e. System voltages.

f. Grounding scheme (resistance grounding, solid grounding, or no grounding).

3. Calculations: Include the following:

a. Determine the paths and situations where short circuit currents are the greatest. Assume bolted faults and calculate the three-phase and line-to-ground short circuits of each case.

b. Calculate the maximum and minimum fault currents.

G. Provide Time-Current Curves (TCC) on 8-1/2 x 11 log-log paper.

1. The Time Current Curves shall be presented in series only. Parallel branches shall not appear on the same TCC presentation.

2. Do not put more than one branch of protective devices on any one coordination curve.

3. Show a maximum of five devices in series on one TCC. Include a one-line diagram and the names of each protective device in the branch on the coordination curve drawing. Use the same color for the same protective device appearing on different TCC presentations.

4. Provide separate drawings for ground fault coordination curves.

5. Use the names designated in the Contract Documents.

6. Include motor starting curves and transformer inrush and damage curves, and cable short circuit withstand curves.

2.03 ARC FLASH HAZARD STUDY

A. The Power System Study shall include an Arc Flash Hazard Study that shall present the level of arc flash hazard for each item of electrical equipment, and the appropriate level of protection required per OSHA standards.

B. The analysis shall be performed with the aid of computer software intended for the purpose, to calculate Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances.

C. The analysis shall be performed under each possible condition and shall identify the worst-case Arc-Flash condition. The preliminary report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

D. The calculations shall be performed in accordance with IEEE 1584 and safe approach requirements determined in accordance with NFPA-70E. (Latest versions)

E. Results of the Analysis shall be submitted in tabular form on an Excel spread sheet, and shall include, device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment and AFIE levels. The analysis shall be presented on paper and included with the specified electronic format files.

F. After approval of the Study, provide the Arc Flash Hazard Warning Labels. The Study Engineer shall oversee the installation of the required labels for each item of electrical equipment furnished on the project and for each item of existing equipment for which the arc flash hazard has changed. A typical warning label shall be submitted with the Study for approval, and shall include the information listed below, at minimum.

1. Flash Hazard Protection Boundary.

2. Limited Approach Boundary.

3. Restricted Boundary.

4. Incident Energy Level.

5. Required Personal Protective Equipment Rating.

6. Type of Fire Rated Clothing.

G. Labels shall be affixed to the enclosures, in a readily visible location, for all power-handling equipment as follows.

1. Switchgear

   a. One label for the line side of the main breaker

   b. One label for the load side of the main breaker (switchgear bus)

   c. One label on each vertical section, indicating the data for the switchgear bus

2. MCCs

   a. One label for the line side of the main breaker

   b. One label for the load side of the main breaker (MCC bus)

   c. One label on each vertical section, indicating the data for the MCC bus.

3. Switchboards

   a. One label for each switchboard operated at 480 Volts or above.

   b. Label to indicate data for line side of the main breaker.

4. Panelboards

   a. One label for each panelboard operated at 480 Volts or above.

   b. Label to indicate data for line side of the main breaker.

5. Control panels, including combination starters.

   a. Single label at each unit operated at 480 Volts or above.

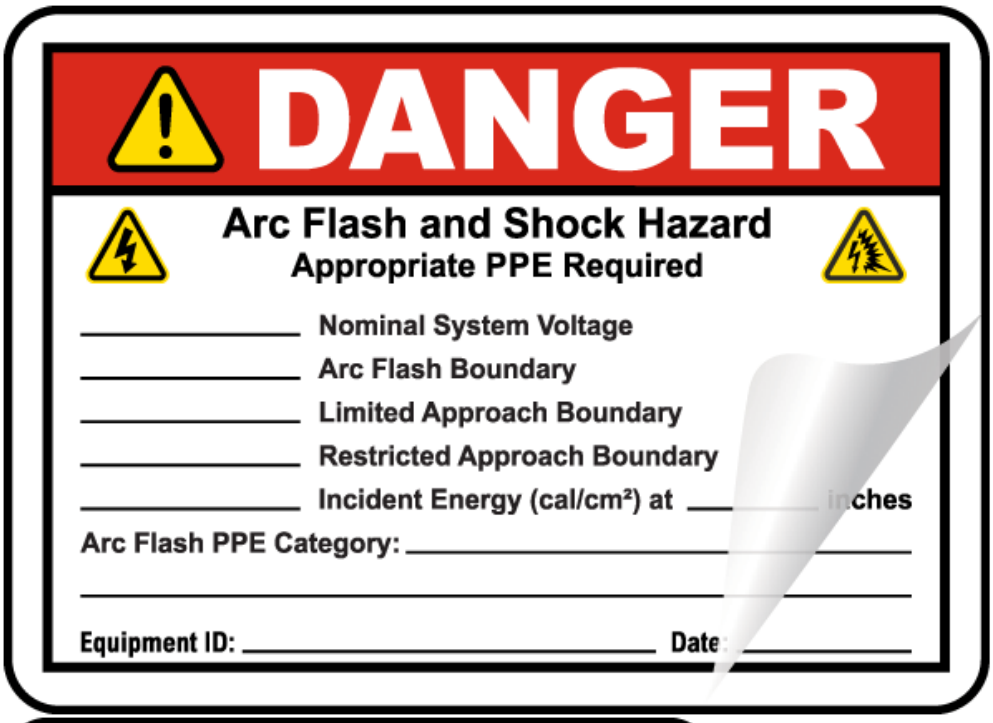
   b. Label to indicate data for the line side of the disconnect device.

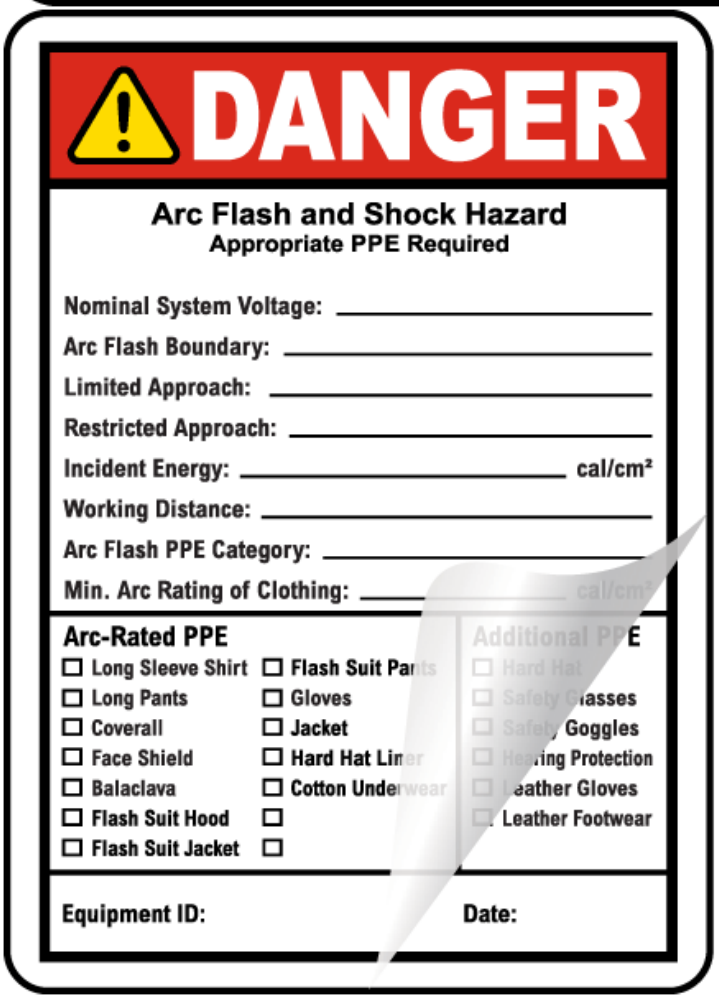
6. Disconnect switches.

   a. Single label at each disconnect switch operated at 480 Volts or above.

   b. Label to indicate data for the line side of the switch.

H. Size of each label shall be not less than 4 inches wide and 3 inches tall. Two samples are shown below:


DANGER
Arc Flash and Shock Hazard
Appropriate PPE Required
Nominal System Voltage
Arc Flash Boundary
Limited Approach Boundary
Restricted Approach Boundary
Incident Energy (cal/cm²) at
inches
Arc Flash PPE Category:
Equipment ID:
Date:


DANGER
Arc Flash and Shock Hazard
Appropriate PPE Required
Nominal System Voltage:
Arc Flash Boundary:
Limited Approach:
Restricted Approach:
Incident Energy:
cal/cm²
Working Distance:
Arc Flash PPE Category:
Min. Arc Rating of Clothing:
Arc-Rated PPE
Long Sleeve Shirt
Long Pants
Coverall
Face Shield
Balaclava
Flash Suit Hood
Flash Suit Jacket
Flash Suit Pants
Gloves
Jacket
Hard Hat Liner
Cotton Underwear
Additional PPE
Hard Hat
Safety Glasses
Safety Goggles
Hearing Protection
Leather Gloves
Leather Footwear
Equipment ID:
Date:

PART 3 EXECUTION

3.01 FIELD SERVICES

A. Label Installation Certification

1. When the label installation is complete, the Contractor, the Study Engineer and the Owner/Engineer shall jointly inspect each location and show to the Owner/Engineer's satisfaction that labels are installed in all the specified locations, and in any additional recommended locations indicated in the Study.

B. Training

1. Provide the services of the Arc-Flash Training Engineer to conduct a training program for the Owner's personnel. The class shall include the following:

   a. The class shall be held for not less than one eight-hour day for each shift of maintenance and operational personnel.

   b. The care, application and use of protective personal equipment described by the warning signs installed on the project.

   c. Conduct training at a location onsite to be designated by the Owner. Include class sessions in the field at equipment locations as may be required for instruction.

   d. Applicable information from the Power System Study shall be provided to all the attendees.

   e. Submit a detailed class syllabus to the Engineer/Owner for review and approval prior to holding the training class.

2. Provide the services of the Power System Study Engineer to conduct power system operation training for the Owner's personnel. The class shall include the following:

   a. The class shall be held for not less than one eight-hour day for each shift of maintenance and operational personnel.

   b. Instruction in the safe operation of the power system for both new electrical power distribution equipment included in the study and existing power distribution equipment which is in series with the new equipment.

   c. The safe operation of electrical equipment Kirk Key interlocks.

   d. Power system switching which avoids configurations that may exceed equipment short circuit ratings, or that may cause other undesirable or danger if certain circuits are paralleled.

e. Provide handout materials including one-line diagrams and O&M information for each person in attendance.

f. Submit a detailed class syllabus to the Engineer/Owner for review and approval prior to holding the training class.

C. The cost of Field Services shall be included in the Contract Price and the schedule for training shall be included in the Contract Schedule.

D. The Owner reserves the right to videotape the training for the Owner's use.

END OF SECTION

SECTION 26 08 13
ACCEPTABLE TESTING AND CALIBRATION

PART 1 GENERAL

1.01 SUMMARY

A. This section provides the guidelines for testing of electrical equipment, low voltage cable, circuit breakers, motors, and related apparatus to be used for the site interior and exterior electrical distribution system. This specification does not release the Contractor or vendor from any further testing required for safe commissioning of the equipment.

1.02 MEASUREMENT AND PAYMENT

A. Payment includes all materials, equipment, labor, and testing for complete installation as indicated on the drawings and described in this section and shall be included in the lump sum bid price for Electrical per project site.

1.03 QUALITY ASSURANCE

A. National Electric Testing Association Standards for acceptance testing of Electrical Distribution Apparatus, Publication 2.001, and IEEE Publication No. 141, are hereby made a part of this section, unless otherwise modified herein.

1.04 TESTS

A. All tests, other than Low Voltage Systems and Equipment, will be supervised by the Owner. The Contractor will give a one-week notice of all scheduled tests to the Owner in writing. If a third party is conducting the tests, the Contractor's presence will be required also.

B. Provide tests as required by specific sections of these Division 26 specifications. Review Division 26 requirements for other testing not specifically mention in this section.

C. Under this specification, the Contractor shall perform the electrical tests on the following equipment and as specified under Part 3, Execution. The Contractor will supply all equipment required to perform all testing responsibilities.

1. Low voltage cable.

2. Motors.

3. All controls for miscellaneous motors.

4. Grounding.

D. The Contractor will notify the Owner of scheduled dates of electrical equipment installation completion. Equipment testing will be coordinated at this time by Contractor with Owner and appropriate Manufacturer's Representatives.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.01 PREPARATORY WORK

A. Prior to the testing of any specific piece of equipment, the Contractor will remove all shipping hardware and inspect for broken or missing parts and proper connections in accordance with the manufacturer's instructions.

3.02 GENERAL

A. Submit directly to the Engineer three (3) copies of all test reports certified by the testing technician.

MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No.:_____ Specification Section: _____
Equipment Name: _____
Contractor: _____
Manufacturers of an equipment item: _____

The undersigned manufacturer certifies that a service ENGINEER has instructed the water treatment operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Start-up procedure reviewed
Shutdown procedure reviewed
Normal operation procedure reviewed
Others:

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency)
Described special tools required
Described normal items to be reviewed for wear
Described preventive maintenance instructions
Described greasing frequency
Others:

Date: _____ Manufacturer: _____
Signature of Authorized Representative

Date: _____ _____
Signature of Owner's Representative

Date: _____ _____
Signature of Contractor's Representative

MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No.:_____ Specification Section: _____

Equipment Name:_____

Contractor: _____

Manufacturer of equipment item: _____

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations and that the trial operation of the equipment item has been satisfactory.

Comments: _____

Date: _____ Manufacturer: _____

Signature of Authorized Representative: _____

Date: _____ Contractor: _____

Signature of Authorized Representative: _____

END OF SECTION

SECTION 26 22 13
LOW VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the Drawings.

B. The provisions of this Section shall apply to all dry-type distribution transformers, except as indicated otherwise.

1.02 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

B. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 26 05 74. Submittals made prior to such approval will be returned without review.

C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

D. All equipment supplied under this Section of the Specifications shall be products of the same Manufacturer and shall be contained in one single submittal. Partial submittals will be returned without review. Submittals shall also contain information on related equipment to be furnished under this Specification but described in the related sections listed in the Related Work paragraph above. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

E. Equipment specified in Process Equipment and Mechanical Equipment Divisions and supplied as an integral part of a process equipment manufacturer's package, but referred to this Section for component details, shall be submitted with the manufacturer's package in those Divisions.

F. Shop Drawings and Product Data. For each transformer specified under this Section, submit the following information:

1. Outline dimensions and weights
2. Typical/Design test data
3. Transformer ratings including:
    a. kVA
    b. Primary and secondary voltage
    c. Taps
    d. Basic impulse level (BIL) for equipment over 600 volts
    e. Design impedance
    f. Insulation class and temperature rise
    g. Test reports are required for equivalent of supplied transformers 300 KVA and above, indicating losses at 25, 50, 75 and 100 percent rated load and sound levels.
    h. Catalog data.
    i. Sound level.
4. Product data sheets
5. Connection diagrams
6. Installation information
7. Date of manufacture for each transformer
8. Seismic Certification
9. Where applicable the following additional information shall be submitted to the Engineer:
    a. Specified accessories

G. Operation and Maintenance Manuals.

1. Operation and Maintenance Manuals shall include the following information:

    a. Manufacturer's contact address and telephone number for parts and service.

    b. Instruction books and/or leaflets

    c. Recommended renewal parts list

    d. Record Drawings of information required by the Submittals part of this Section.

    e. Project record drawings clearly indicating operating features and including as-built shop drawings, outline drawings, and schematic and wiring diagrams.

1.04 REFERENCE STANDARDS

A. The dry-type transformer(s) and all components shall be designed, manufactured and tested in accordance with the latest applicable NEMA and ANSI standards as follows:

1. DOE 2016 Energy Efficiency Standards, 10 CFR Part 431

2. ANSI No. C89.2: Dry Type Transformers for General Applications

3. ANSI C57.96 2004 Guide for Loading Dry-Type Distribution and Power Transformers

4. ASTM D635 – Standard Test Method for Insulation Materials

5. NEMA ST20 Dry-Type Transformers for General Applications

6. UL 1561 Standard for Dry Type-Type General Purpose and Power Transformers

7. IEEE-519 Standards for Harmonic Control in Electric Power Systems

8. NFPA 70 – National Electrical Code

1.05 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer. Equipment that is manufactured by a third party and "brand labeled" shall not be acceptable.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.

E. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

F. Transformers manufactured more than 24 months prior to the date of this Contract will not be acceptable.

G. Transformers shall meet the US Department of Energy (DOE) 2016 Energy Efficiency Standards 10 CFR Part 421.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.,

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at time of shipment, and shall be made available to the Contractor and Owner/Engineer

C. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. All accessories shall be packaged and shipped separately.

D. Equipment shall be equipped to be handled by crane. Where cranes are not available, equipment shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

E. Equipment shall be installed in its permanent finished location shown on the Drawings within seven calendar days of arriving onsite. If the equipment cannot be installed within seven calendar days, the equipment shall not be delivered to the site, but stored offsite, until such time that the site is ready for permanent installation of the equipment with no change in Contract Price or Schedule.

F. Where space heaters are provided in equipment, provide temporary electrical power, and operate space heaters during jobsite storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.07 WARRANTY

A. Provide warranties, including the manufacturer’s warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for three years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner

1.08 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. ABB
2. Eaton
3. Schneider Electric
4. Siemens
5. Approved equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

A. The ratings of the transformer shall be as follows:

1. kVA Rating: As shown on the Drawings.
2. Impedance: ANSI Standard Tolerance
3. HV: As shown on the Drawings.
4. LV: As shown on the Drawings.
5. LV: As shown on the Drawings.

2.03 CONSTRUCTION

A. Insulation Systems

1. Transformer insulation system shall be as follows:
    a. Up to 15 kVA, three-phase and single-phase: UL recognized 180°C rated insulation system, encapsulated with 115°C rise.
    b. 15 kVA, and above, three-phase and single-phase: UL recognized 200°C rated insulation system, ventilated, with 115°C rise.
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, and a 24-hour average ambient of 30°C

3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

4. Windings shall have a BIL of 10 kV minimum.

B. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.

2. Transformer coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants) free water reducible electrical varnish to give good corrosion resistance. The assembly shall be installed on vibration-absorbing pads.

3. On single and three-phase units rated 15 kVA and below, the core and coil assembly shall be encapsulation system and shall minimize the sound level. Enclosure construction shall be encapsulated, non-ventilated 316 stainless steel enclosure, with lifting eyes.

4. On single and three-phase units, rated above 15 kVA, the core and coil assembly shall be ventilated, weatherproof 316 stainless steel enclosure. All ventilation openings shall be protected against falling dirt. The assembly shall be installed on vibration-absorbing pads.

5. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.

6. The neutral bus shall be configured to accommodate 200% of the rated current.

C. Taps

1. Three-phase transformers rated 15 through 500 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage

2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.

D. Isolation Pad

1. Each transformer, pad-mounted, bracket-mounted, or suspended, shall utilize double deflecting neoprene mounting vibration isolators as manufactured by Mason Industries Type ND, sized according to rated capacities.

E. Finish

1. Enclosures, other than stainless steel, shall be finished with ANSI Gray color, weather-resistant enamel.

F. Accessories

1. On ventilated outdoor units provide suitable weather shields over ventilation openings.

2. Lug kits shall be provided by the Manufacturer of the transformer.

G. Electrostatic Shielding

1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of an independent single full width electrostatic shield consisting of a single turn of copper placed between the primary and secondary winding and grounded to the housing of the transformer.

   a. Electrostatic shield shall provide primary-to-secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.

   b. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL Std. 220A, Method of Insertion Loss Measurement, with matched impedance no load technique.

      1) Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz,

      2) Common mode noise attenuation: Minus 55 dBA minimum at 1.51 kHz to 100 kHz.

      3) Normal mode (Transverse mode) noise attenuation: Minus 35 dBA minimum at 1.5 kHz to 10 kHz

H. Motor Drive Isolation

1. Where shown on the drawings, provide motor drive isolation transformers.

2. Motor drive isolation transformers shall be designed for use with three-phase AC adjustable frequency drives 600 volts and below to provide isolation between the incoming line and drive circuitry. The drive isolation transformers shall minimize the line disturbances caused by SCR firing within the drive unit. Thermogurads shall be included in all motor drive isolation transformers to provide additional protection for the transformer from increased heating due to the non-sinusoidal characteristics of the drive currents. The transformer shall provide reduced short-circui9t currents and voltage line transients. The transformer shall be specifically sized to the drive kVA requirements dictated by the horsepower of the motor and specified drive size as specified and/or shown on the drawings. The transformers shall be mechanically braced to withstand the stress of current reversals and short-circuit currents associated with the specific drive kVA rating.

3. Motor drive isolating transformer shall have harmonic mitigation features as follows:

   a. Transformers shall provide all the features specified herein. In addition, they shall be two-winding construction. The primary winding shall be delta connected and the secondary winding shall be wye-zigzag with a wye field connection.

   b. Provide low positive / negative sequence impedance between 4.6% and 7.2%, low zero-sequence impedance / reactance less than 0.55% and 0.47% respectively.

   c. Triplen harmonics shall be treated in the secondary windings through flux cancellation and not coupled into the primary delta winding.

   d. The transformer shall treat the 5^{th} and 7^{th} harmonic currents through the pairing of transformers such that these harmonic currents subtract at the common bus feeding the transformers with harmonics produced by other similar sources.in the secondary windings in the secondary windings.

   e. Fundamental current imbalance shall be reduced on the primary when compared to the secondary load measurements.

   f. Harmonic treatment shall be accomplished through electromagnetic means. Filters, capacitors, power electronic circuitry or other such devices shall not be used to mitigate harmonics.

   g. Provide thermal sensors set at 190°C to trip and a second set of sensors set at 175°C to alarm. Thermal sensors shall be factory-installed in the center of the transformer coil and factory-wired to terminal blocks. Thermal sensors output shall be dry contacts.

2.04 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest applicable ANSI and NEMA standards.

   1. Ratio tests at the rated voltage connection and at all tap connections

2. Polarity and phase relation tests on the rated voltage connection
3. Applied potential tests
4. Induced potential test
5. No-load and excitation current at rated voltage on the rated voltage connection

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all equipment per the manufacturer's recommendations and the contract drawings.

B. Verify the house keeping pad size required and construct as shown or specified.

C. Securely connect all neutrals and transformer enclosures to ground.

3.02 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.

3.03 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION

SECTION 26 24 13
SWITCHBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor and install, where indicated, a free-standing, dead-front type front accessible low voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the Contract Drawings. Maximum floor space is indicated on drawings. Equipment footprint exceeding designated footprint will not be considered.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

1.03 RELATED WORK

A. Division 01

B. Section 16195 – Electrical Identification.

1.04 REFERENCES

A. The low voltage distribution switchboard assembly and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:

1. NEMA PB-2
2. UL Standard 891.

1.05 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted in accordance with Division 01 and Section 26 05 01:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line
6. Schematic diagram

7. Nameplate schedule
8. Component list
9. Conduit entry/exit locations
10. Assembly ratings including:
    a. Short-circuit rating
    b. Voltage
    c. Continuous current
11. Major component ratings including:
    a. Voltage
    b. Continuous current
    c. Interrupting ratings
12. Cable terminal sizes
13. Product data sheets.

1.06 SUBMITTALS – FOR RECORD PURPOSES

A. The following information shall be submitted for record purposes:

1. Final (as-built) drawings and information for items listed in the previous paragraph.
2. Wiring diagrams
3. Certified production test reports
4. Installation information

B. The final (as-built) drawings shall include the same drawings as the original construction drawings and shall incorporate all changes made during the manufacturing process.

1.07 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the circuit protective devices within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The maximum area for the switchboard is indicated on the drawing. The manufacturer will provide statement of conformance at the time of bid submittal to the contractor.

1.08 REGULATORY REQUIREMENTS

A. The low voltage switchboard shall be UL labeled.

1.09 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Eaton.

B. General Electric.

C. Square D.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with this specification and manufactured by others not named will be considered only if approved by the Engineer, they must be received for review 14 days prior to bid date.

2.02 RATINGS

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current as listed on the Contract Drawings.

B. Voltage rating to be as indicated on the drawings.

2.03 CONSTRUCTION

A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

B. All sections of the switchboard shall align front and rear with depth as shown on the drawings. All branch protective devices shall be group mounted. Devices shall be front removable and load connections front and rear accessible. Rear access shall be provided. Provide barriers between each structure and between lug connections and horizontal busses. There shall be a vertical barrier of glass polyester between the device compartment and the bus compartment.

C. The assembly shall be provided with adequate lifting means.

D. Provide a rear compartment vertical insulating barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.

E. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

2.04 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. A copper ground bus (minimum 1/4 x 2 inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.05 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

B. Copper or bronze type terminals shall be provided for all line and load terminations suitable for copper cable rated for 75 degrees C of the size as indicated on the drawings.

C. Copper or bronze lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle-type terminals provided are integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

E. Comply with Specification Section 16195, Electrical Identification.

2.06 MAIN PROTECTIVE DEVICE

A. The main protective device shall be a manually operated, fixed mounted, insulated case circuit breaker, Eaton Magnum SB or approved equal with a minimum interrupting rating of 85,000 amperes RMS Symmetrical. The main protective device trip unit shall be Eaton Digitrip 1150+ or approved equal.

2.07 FEEDER PROTECTIVE DEVICES

A. Feeder protective devices shall be thermal-magnetic, molded case circuit breakers with minimum interrupting ratings of 65,000 amperes RMS Symmetrical.

2.08 METERING

A. Provide a GE Multilin PQM II solid state digital metering unit with current transformers for metering the main circuit breaker.

2.09 ENCLOSURE

A. NEMA 1A Enclosure.

2.10 NAMEPLATES

A. See Specification Section 26 05 53, Electrical Identification.

B. Control components mounted within the assembly such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.11 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

2.12 TRANSIENT VOLTAGE SURGE SUPPRESSION

A. Provide a transient voltage surge suppression unit for the main circuit breaker rated 300 kA per phase and 150 kA per mode.

2.13 SHORT CIRCUIT AND COORDINATION STUDY

A. Provide a short circuit and coordination study to determine settings for all circuit breakers with adjustable trip settings. Program circuit breakers with trip unit settings.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

1. All switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground

B. The manufacturer shall provide ten (10) certified copies of factory test reports.

3.02 TRAINING

A. The Contractor shall provide a training session for up to ten (10) owner's representatives for four (4) hours at the jobsite location. Training and instruction time shall be in addition to that required for start-up service.

B. The training shall be conducted by the manufacturer's qualified representative.

C. The training program shall consist of the following:

1. Instructions on the proper operation of the assembly, circuit breakers, and major components within the assembly

2. Instructions on the proper maintenance of the equipment.

3.03 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and the National Electrical Code.

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

END OF SECTION

SECTION 26 24 16
LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install assemblies of low voltage motor control centers (MCCs), together with appurtenances, complete and operable, as specified herein and as shown on the Contract Drawings.

B. Automatic transfer switches, automatic transfer schemes, variable frequency drives, SPDs and programmable controllers shall be factory installed by the motor control center manufacturer as shown on the Drawings.

C. Motor control centers shall be sized to include all equipment, spares and spaces shown on the Drawings.

1.02 RELATED WORK

A. Refer to Division 26 05 01 for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

B. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 26 05 74. Submittals made prior to such approval will be returned unreviewed.

C. Provide systems engineering to produce coordination curves, showing coordination between existing and/or new protective devices and breakers and/or fuses submitted, such that protective device coordination is accomplished. Such curves and settings shall be included as a part of these submittals.

D. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will be returned unreviewed.

E. Provide original equipment manufacturer (OEM) created equipment shop drawings, including all wiring diagrams, created in the manufacturer's Engineering department. All equipment shop drawings shall bear the original equipment manufacturers logo, drawing file numbers, and shall be maintained on file in the OEM's archive file system. Photocopies of the Engineer's ladder schematics are unacceptable as shop drawings.

F. Submit to the Owner/Engineer, shop drawings and product data, for the following:

1. Equipment outline drawings showing elevation and plan views, dimensions, weight, shipping splits and metering layouts. Indicate all options, special features, ratings and deviations from the Specifications.

2. Conduit entrance drawings, including floor penetrations.

3. Bus arrangement drawings.

4. Unit summary tables showing detailed equipment description and nameplate data for each compartment.

5. Product data sheets and catalog numbers for overcurrent protective devices, motor starters, control relays, control stations, meters, pilot lights, etc. List all options, trip adjustments and accessories furnished specifically for this project. Clearly mark each sheet to indicate which items apply and/or those items that do not apply. Unmarked cut sheets will cause rejection of the submittal and its return for revision.

6. Provide control systems engineering to produce custom unit elementary drawings showing interwiring and interlocking between units and to remotely mounted devices. Show wire and terminal numbers. Indicate special identifications for electrical devices per the Drawings.

7. Master drawing index

8. Front view elevation

9. Floor plan

10. Top view

11. Equipment weights

12. Single line

13. Schematic diagram, including manufacturer's selections of component ratings, and CT and PT ratios.

14. Nameplate schedule

15. UL Listing of the completed assembly.

16. Component list with detailed component information, including original manufacturer's part number.

17. Conduit entry/exit locations

18. Assembly ratings including:

    a. Short-circuit rating

    b. Voltage

    c. Continuous current

19. Major component ratings including:

    a. Voltage

    b. Continuous current

    c. Interrupting ratings

20. Descriptive bulletins

21. Product data sheets.

22. Number and size of cables per phase, neutral if present, ground and all cable terminal sizes.

23. Key interlock scheme drawing and sequence of operations.

24. Busway connection and amperage rating.

25. Instruction and renewal parts books.

26. Itemized list of spare parts furnished specifically for this project, including quantities, description and part numbers.

G. Harmonic distortion calculations for Variable Frequency Drives (VFDs).

H. Factory Tests. Submittals shall be made for factory tests specified herein.

I. Field Test Reports. Submittals shall be made for field tests specified herein.

J. Operation and Maintenance Manuals.

1. Operation and maintenance manuals shall include the following information:

    a. Manufacturer's contact address and telephone number for parts and service.

    b. Instruction books and/or leaflets

c. Recommended renewal parts list

d. Record Documents for the information required by the Submittals paragraph above.

K. Submit for approval, a manufacturer's conducted training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual.

1.04 REFERENCE CODES AND STANDARDS

A. The low voltage motor control centers and all components in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NEMA Standards

a. ICS 1 - General Standards for Industrial Control and Systems

b. ICS 2 – 2000 Industrial Control and Systems

c. SG-3 – Low Voltage Power Circuit Breakers

d. ICS 4: Terminal Blocks for Industrial Use American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL)

e. NEMA ICS 10 – AC Transfer Switch Equipment.

2. American National Standards Institute / Underwriters Laboratories, Inc. (ANSI/UL)

a. 467: UL Standard for Safety, Grounding and Bonding Equipment

b. 489: UL Standard for Safety, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

c. 506: UL Standard for Safety, Specialty Transformers

d. UL 508C UL requirements for power conversion equipment.

e. UL 845 – Electric Motor Control Centers

f. UL 991 - Tests for Safety-Related Controls Employing Solid-State.

g. UL 1008 – Transfer Switches.

3. National Fire Protection Association (NFPA

a. NFPA 70 – National Electrical Code (NEC)

b. NFPA 70E – Standard For Electrical Safety in the Workplace

c. NFPA 110 – Emergency and Standby Power Systems.

4. Institute of Electrical and Electronics Engineers

a. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems

5. American National Standards Institute / Institute of Electrical and Electronics Engineers (ANSI/IEEE)

a. ANSI IEEE Standard C62.41-1991 Surge Withstand Capacity

b. ANSI IEEE Standard 519-1992 Harmonic limits

6. CSA 22.2, No. 14 & 66 CSA requirements for power electronics

7. FCC Part 15, Sub Part J, Class A RFI/EMI emission standards

B. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of the equipment provided shall have produced similar equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The manufacturer of the assembly provided shall be the manufacturer of the major components within the assembly. All assemblies provided shall be manufactured by the same manufacturer. Equipment that is manufactured by a third party and “brand labeled” will not be acceptable.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.

E. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at time of shipment and shall be made available to the Contractor and Owner/Engineer.

C. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

D. Equipment shall be equipped to be handled by crane. Where cranes are not available, equipment shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

E. Equipment shall be installed in its permanent finished location shown on the Drawings within seven calendar days of arriving onsite. If the equipment cannot be installed within seven calendar days, the equipment shall not be delivered to the site, but stored offsite, until such time that the site is ready for permanent installation of the equipment with no change in Contract Price or Schedule.

F. Space heaters provided in equipment shall be provided with temporary electrical power to operate during jobsite storage and after equipment is installed in permanent location. Space heater operation shall be continuous until equipment is powered and placed in service.

1.07 WARRANTY

A. Provide warrantees, including the manufacturer’s warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for three years except for variable frequency drives which shall be for three years, from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Eaton

2. ABB

3. Rockwell

4. Schneider Electric Co

5. Siemens

6. No equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

A. The service voltage, overall short circuit withstand, and interrupting rating of the equipment and devices shall be as shown on the Drawings. Main and feeder circuit protective devices shall be fully rated for the specified short circuit duty. Systems employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested, and UL labeled for the specified short circuit duty in combination with the motor branch circuit protective device.

B. The continuous current rating of the main horizontal bus shall be as shown on the Drawings. Vertical busses shall be sized for the structure load and shall have a minimum rating of 300 amperes.

C. Motor control centers, including devices, shall be designed for continuous operation at rated current in a 40°C ambient temperature.

D. For additional ratings and construction notes, refer to the Drawings.

2.03 CONSTRUCTION

A. General

1. Refer to Drawings for: actual layout and location of equipment and current ratings of devices, bus bars, components; voltage ratings of devices, components, and assemblies; protective relays, and other required details.

2. Control units shall be arranged as shown on the Drawings.

3. All instrumentation and monitoring equipment for wastewater applications must have power surge protection per TCEQ 217.161.b.

4. Provide a factory-installed dedicated Point of Utilization Device (SPD) specified in Section 26 43 13, for the equipment

5. The MCC construction and wiring shall be NEMA Class I, Type B as specified in ANSI/NEMA ICS-2-322.08 and ICS-2-322.10. Provide an MCC designed for 3 phase, 60 Hz, 480-Volt service with main horizontal and vertical bus ampacities and short circuit bracing as specified on the one-line diagram. Provide NEMA Class IIB wiring for interconnection wiring as specified on drawings.

6. Furnish an MCC designed to operate in service conditions described in NEMA ICS 1 and as shown on the one-line diagram.

7. Supply motor starters suitable for full voltage starting unless otherwise noted on the one-line diagram.

8. Construct the MCC of one or more vertical sections bolted together to form a free-standing assembly, designed to permit future additions, changes, or regrouping of units.

9. Provide motor control units of the combination type, consisting of a motor circuit protector (MCP), a magnetic starter and a control power transformer. Size the MCP and starter in accordance with manufacturer's recommendation for the starter and motor size indicated on the one-line diagram.

10. When power factor correction capacitor is called for, connect its wiring to the line side of the overload relay with a set of fuses, a circuit breaker, or other acceptable means to serve as overload protection for the wiring and capacitor.

11. Manufacture main breaker (if used) and feeder breakers of the molded case, thermal-magnetic type to be mounted and wired in accordance with ANSI/UL 489.

12. If called for on the one-line-diagram, locate the lighting panelboard, transformer and transformer feeder breaker in the same vertical section. Supply a transformer with 115 degrees C temperature rise, installed in accordance with ANSI/UL 506.

B. Nameplates

a. External

1) Furnish nameplates for each device as specified herein and as indicated on the Drawings. All nameplates shall be laminated plastic, black lettering on a white background, attached with stainless steel screws. There shall be a master nameplate that indicates equipment ratings, manufacturer's name, shop order number and general information. Cubicle nameplates shall be mounted on the front face. Nameplates shall be engraved, laminated impact acrylic, matte finish, not less than 1/16-inch thick by 3/4-inch by 2-1/2-inch, Rowmark 322402 or equal. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X 1/2 inch, or equal. Prior to installing the nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues has been removed. Epoxy adhesive or foam tape is not acceptable.

b. Internal

1) Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification, corresponding to appropriate designations on manufacturer's wiring diagrams.

c. Special

1) Identification nameplates shall be white with black letters, caution nameplates shall be yellow with black letters, and warning nameplates shall be red with white letters.

2. Control Devices and Indicators

a. All operating control devices, indicators, and instruments shall be securely mounted on the panel door. All controls and indicators shall be 30-millimeter, corrosion resistant, NEMA 4X/13, anodized aluminum, or reinforced plastic. Booted control devices are not acceptable. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical and electrical equipment requirements.

b. Indicator lamps shall be LED type with transformer and 100,000-hour lamp life. For all control applications, indicator lamps shall incorporate a push-to-test feature. Lens colors shall be as follows:

1) Red for ON, Valve OPEN, and Breaker CLOSED.

2) Green for OFF, Valve CLOSED and Breaker OPEN.

3) Amber for FAIL.

4) Blue for READY

5) White for POWER ON.

c. Mode selector switches (HAND-OFF-AUTO, LOCAL-OFF-REMOTE, etc.) shall be as shown on the Drawings. Units shall have the number of positions and contact arrangements, as required. Each switch shall have an extra dry contact for remote monitoring.

d. Pushbuttons, shall be as follows:

1) Red for STOP, Valve OPEN, Breaker OPEN and mushroom Red for EMERGENCY STOP.

2) Green for START, Valve CLOSE and Breaker CLOSE.

3) Black for RESET.

e. Furnish nameplates for each device. All nameplates shall be laminated plastic, black lettering on a white background, attached with stainless steel screws. Device mounted nameplates are not acceptable.

f. The manufacturer shall not remove, reuse, alter, or replace original equipment nameplates or equipment tags associated with equipment or components supplied by the manufacturer's suppliers and sub-suppliers.

3. Control and Instrument Power Transformers

a. Control power transformers, encapsulated, shall be provided where shown on the Drawings. Transformer shall be sized for the entire load, including space heaters, plus 25% spare capacity, and shall be not less than 100 VA. Provide a load calculation showing the sizing of the control power transformer complies with this requirement.

b. Control power transformers shall be 120 volts grounded secondary. Primary side of the transformer shall be fused in both legs. One leg of the transformer secondary shall be solidly grounded while the other leg shall be fused.

4. Current Transformers

a. Current transformers shall be furnished as indicated on the contract drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. The location for the current transformers shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections.

b. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

c. Current transformers used on power quality meters shall be instrument accuracy.

d. Relays and meters shall not be placed on the same CT.

e. Differential relays shall be placed on dedicated CTs.

C. Enclosures

1. Structures shall be NEMA Type 1A unless noted otherwise on the Drawings.

2. Motor control centers shall consist of a series of metal enclosed, free standing, dead front vertical sections bolted together to form double wall construction between sections. Individual vertical sections shall be nominally 90 inches high, 20 inches wide and 20 inches deep unless otherwise shown on the Drawings. Vertical sections shall be mounted on steel channel sills. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full width of each shipping split. Top of each section shall have removable plates with lifting angle. MCCs shall be constructed to allow field installation of additional sections to each end and shall be provided with full depth cover plates (rodent barriers) at each end of the motor control center channel sills.

3. Provide continuous top and bottom horizontal wireways extending the full width of the lineup, isolated from the horizontal bus. Provide a four-inch wide, full height, vertical wire way in each section, equipped with a hinged door and cable supports. Vertical wire way shall be isolated from the bus and device compartments. Wireways or other metal member's openings shall have rolled edges or protective grommets.

4. All cables shall enter and exit underground from the bottom of the structure, unless otherwise shown on the Drawings.

5. Provide individual, flange formed, pan type door with concealed hinges and quarter turn latches for each device compartment and future space. Doors shall be removable. Door removal shall not be required to withdraw starter units or feeder tap devices.

6. Motor control centers shall be designed for mounting against the wall or back-to-back with another MCC. All wiring, bus joints and other mechanical parts requiring tightening or other maintenance shall be accessible from the front or top.

7. Each vertical section shall be divided into no more than six compartments which shall contain a feeder breaker, combination motor control unit, or other control assemblies connected to a common vertical power bus.

8. Vertical sections shall contain horizontal wire ways at top and bottom of the structure. The design shall be such to permit a continuous wiring trough from end to end of the entire width of the motor control center. End vertical sections shall have cover plates, which can be easily removed to allow continuation of wire ways and horizontal bus extensions for future addition of vertical sections.

9. The vertical section shall also have a continuous vertical raceway extending the full height of the structure and shall intersect with the horizontal raceways. This wire way shall be provided with barriers which completely isolate the wire way from the bus compartments, the controller compartment, and the adjacent vertical units. The wire way shall have its own separate hinged door.

10. Combination motor control units (Size 5 and smaller), as well as other electrical assemblies, including feeder tap units (225 ampere and smaller), shall be provided with appropriately rated stab assemblies for draw out (plug-in) type construction.

11. Plug in provisions shall include a positive guide rail system and stab shrouds to insure alignment of stabs with the vertical bus. The stab shall be designed to increase bus contact pressure during a fault. The stab design shall assure a consistent low resistance contact with the vertical bus, even after repeated insertions and removals. The unit shall be equipped with a lockout mechanism to lock the drawer in an extended or stabbed position for maintenance and testing. Each draw out compartment shall have a separate hinged removable door.

12. Each unit compartment shall be provided with an individual front hinged door. Motor control and feeder units shall be interlocked mechanically with a unit disconnect device to prevent unintentional opening of the door while unit is energized. An interlock between the unit disconnect and the structure shall prevent the removal or reinsertion of the unit when the unit is in the "ON" position. Means shall be provided for releasing the interlock for intentional access and/or application of power. Pad locking arrangements shall permit locking the disconnect device in the "OFF" position.

13. The MCC shall be furnished as a completely factory assembled unit where transportation facilities and installation requirements permit. Minimize shipping splits if required.

14. All painted steel work shall be treated with a primer coat and a finish coat, or bonderized and finished with a coat of baked enamel at the factory, such that no field painting will be required except for "touching up" of damaged areas. Color shall be manufacturer's standard.

15. Furnish documentation with the equipment as follows: Compartments containing panel boards shall have a card holder on the inside of the door with the branch circuits clearly identified. Compartments containing motor starters shall each have an overload heater section table posted inside the door. All control compartments shall have a pocket on the inside of the door with a copy of the appropriate schematic and wiring diagram.

16. Where the motor control center is shown outdoors the construction shall be NEMA 3R and shall be as follows:

    a. The MCC shall be non-walk-in weatherproof construction of basic indoor equipment enclosed in a weatherproof enclosure. Gasket all covers, provide filters for ventilation louvers and a sloped roof.

    b. The MCC shall be supported on a heavy gauge, welded steel channel base extending around all four sides, constructed to exclude rodents, vermin, and dust.

    c. All non-current carrying metal parts of the control center assembly shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pretreatment to inhibit rust.

    d. Roof structure shall be watertight with a continuous drip edge channel on the front. Roof shall slope to the rear for water drainage. Holes for lifting eyes shall be blind tapped.

    e. Provide tamper resistant, pad lockable, weathertight, gasketed cubicle doors and switch handle covers, with stainless steel hinge pins.

f. Each vertical section shall have heavy duty, 240 volts AC, space heaters, thermostat controlled, set to cut out when the temperature rises to an ambient of 30 degrees C. Space heaters shall provide sufficient capacity to prevent condensation with the equipment de-energized, while operating at half their rated voltage(240 volt rated space heaters operated at 120 volts). Heaters shall be provided with perforated metal guards and a circuit breaker disconnect. 120-volt AC control power shall be provided internally from the MCC.

g. Each MCC lineup shall have an exhaust fan, thermostatically controlled, for heat dissipation. Power for ventilation fan shall be provided by distribution transformer and panelboard mounted in MCC section as shown on the drawings.

D. Construction

1. Provide individual compartments for each removable combination starter and feeder tap device unit. Each vertical section shall accommodate a maximum of six compartments. Steel barriers shall isolate the top, bottom and sides of each compartment from adjacent units and wireways. Removable units shall connect to the vertical bus in each section with tin plated, self-aligning, pressure type copper plug connectors. Size 6 and larger starter units may be wired directly to the bus. Removable units shall be aligned in the structure on guide rails or shelves and secured with a cam latch mechanism or racking screw.

2. Provide individual, isolated compartments for fixed mounted devices such as circuit breakers, cable lugs, metering, relaying and control devices. Main and bus tie circuit breakers shall be wired directly to the main horizontal bus. All bus connections shall be fully rated.

3. Provide the following features:

a. Provision to padlock removable units in a partially withdrawn TEST position, with the bus stabs disengaged.

b. Provision to padlock unit disconnect handles in the OFF position with up to three padlocks.

c. Mechanical interlock with bypass to prevent opening unit door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.

d. Mechanical split type terminal blocks for disconnecting external control wiring.

e. Auxiliary contact on unit disconnect to isolate control power when fed from an external source.

f. Disconnect operating handles and control devices.

E. Bus Systems

1. The bus support system shall be high dielectric strength, low moisture absorbing high impact material.

2. Bus bracing shall be minimum 65,000 amperes RMS symmetrical, and be equal to or exceed the value shown on the Drawings.

3. Busses shall have uniform cross-sectional area throughout their length. Tapered bus will not be acceptable.

4. All bolted bus mating surfaces and splicing material shall be the same plated material as the bus.

5. The main horizontal bus shall extend the entire length of the motor control center. The main bus bars shall be rated as shown on the Contract Drawings but shall not be less than 600 amperes.

6. Main horizontal bus: Tin plated copper, bolted joints, accessible from the front of the structure, fully rated throughout the lineup, and factory insulated by taping. All field assembled joints shall be taped after installation, equal to the factory bus taping.

7. Vertical section bus: Tin plated copper, full height, totally insulated and isolated by labyrinth design barrier of glass-reinforced polyester, or sandwich insulated/isolated busses, with shutters to cover stab openings when units are withdrawn. Provide fish tape barriers to isolate bottom wireways from lower ends of vertical bus. Bus shall be provided in each vertical draw out section.

8. Vertical busses used for a tie circuit breaker or tie feeder lugs shall be rated for a continuous capacity equivalent to the main horizontal bus rating.

9. Horizontal ground bus: Provide a 300A minimum, continuous tin-plated copper ground bus in each section equipped with lugs for termination of feeder and branch circuit ground conductors. Connect to ground bus in adjacent sections with splice plates. Provide ground bolted connectors for 2/0 AWG minimum wire at each end of the bus.

F. Wiring

1. Wiring: Stranded tinned copper, minimum size #14 AWG, with 600 volt, 90°C, flame retardant, Type MTW thermoplastic insulation, NEMA Class II, Type B. Line side power wiring shall be sized for the full rating or frame size of the connected device. All conductors #1/0 AWG and larger shall be terminated with long barrel NEMA two-hole lugs.

2. Identification: Numbered sleeve type wire markers at each termination point, color coding per NEMA standards and the NEC. Foreign voltage control wiring shall be yellow.

3. All control wiring to draw out units shall be run through split type terminal blocks (draw out) which can be split to allow easy unit removal. Motor "T" leads shall bolt directly to starter or overloads and shall not utilize split type terminal blocks. Terminal blocks shall be of the fully shielded, tubular screw clamp type, resilient collar design to eliminate loose connections. Terminal blocks shall be nickel or tin plated and have exposed wire numbering corresponding to the connected wires. Terminals shall have a maximum of two wires per terminal.

4. All wiring shall be neatly bundled with ty-raps and supported to wire way supports. Control wiring shall be bundled separately from power wiring. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

5. Where "shipping splits" are required between the control compartments and the starter cubicles, interconnecting jumper wires shall be provided for field re-connection.

6. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

7. In general, all conduit entering or leaving a motor control center shall be stubbed up into the bottom horizontal wire way directly below the vertical section in which the conductors are to be terminated or shall enter the motor control center from the top. Conduits shall not enter the motor control center from the side unless approved in writing by the Owner/Engineer.

8. All field wiring and all field-installed internal wiring shall be tagged and coded with an identification number as shown on the Drawings. Coding shall be typed on a heat shrinkable tube applied to each end showing origination and destination of each wire. The marking shall be permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE, or equal.

G. Main Section

1. The MCC main sections shall include the main and tie breakers, metering, and power feeder entrance to the MCC. Where a power feeder entrance is shown on the Drawings, the power feeder entrance section shall be provided. Provide bus extensions and compression lugs for number and size of incoming cables as shown on the Drawings. Where main and tie breakers are shown to be key interlocked, interlocks shall be Kirk-Key type.

2. Where Kirk-Key arrangements are used, the Kirk keyed interlocks shall be Kirk HD Series (Heavy Duty) 316 Series of 316 stainless steel or approved equal.

H. Surge Protective Devices

1. Furnish where shown on the Drawings, or specified herein, a manufacturer provided and installed, Low Voltage Surge Protective Devices (SPD) (Type 2), as specified in Section 26 43 13 of these Specifications. Connection to the MCC shall be with a surge rated disconnect, mounted integral to the MCC.

I. Main Circuit Protective Devices

1. Unless otherwise shown on the Drawings, [single main] or [main-tie-main] [main-tie-tie-main] circuit breakers, with a frame rating larger than 1200 amperes, shall be insulated case (ICCB), 3 Pole, 600 Volt, fixed type, manually operated, with stored energy closing mechanism. Breakers shall be electrically operated where shown as (EO) on the Drawings. Trip device shall be solid state with adjustable long time, short time with short time i^2t switch, adjustable instantaneous settings, and adjustable ground fault settings with i2t switch. Provide overload, short circuit, and ground fault indicator lights. A remote energy-reduction maintenance switch with local indication connected to the instantaneous setting shall be provided to reduce the setting to minimum to reduce arc flash during equipment maintenance.

2. Unless otherwise shown on the Drawings, single main or main-tie-main circuit breakers, with a frame rating of 1200 amperes or less, shall be molded case (MCCB), three-pole, 600-volt, fixed type, manually operated with stored energy closing mechanism. Trip device shall be solid state with adjustable long time, short time with short time i2t switch, adjustable instantaneous settings, and adjustable ground fault settings with i2t switch. A remote energy-reduction maintenance switch with local indication connected to the instantaneous setting shall be provided to reduce the setting to minimum to reduce arc flash during equipment maintenance.

3. Insulated case and molded breakers shall have a UL 489 listing.

4. Main devices shall be equipped with contacts for remote status trip indication and “inhibit” function as shown on the Drawings. Device rating shall be as shown on the Drawings.

J. Automatic Transfer Schemes (ATSCs)

1. Automatic transfer schemes for switching of normal/standby electrically operated circuit breaker arrangements shown on the Drawings to be provided as an integral part of the MCC shall be the voltage and rating shown.

2. ATSC shall be programmable logic controller (PLC) based with a one-hour uninterruptible power supply (UPS), a dedicated Point of Utilization Surge Device (SPD) Type 3, as specified in Section 26 43 13, Individual Control Panel and Related Equipment Protection.

3. The transfer of the load to the emergency source shall occur when any phase of the normal source drops below 80% of normal voltage.

4. The transfer equipment shall be sized to carry full rated current on a continuous 24-hour basis without excessive heating or derating. The transfer equipment shall be capable of withstanding all available system fault currents without opening or damage the contacts during the fault clearing time of the transfer system over current protective device.]

5. The transfer equipment shall be inherently interlocked breakers and shall provide three position operation: closed to normal source, open, closed to emergency source. Time delay between opening of the closed contacts and closing of the open contacts with a minimum of 30 seconds to allow for load stabilization before transfer is complete.

6. The following accessories shall be furnished:

    a. Close differential adjustable phase sensing relay set to drop out at 80% of rated voltage and pick up at 90% of rated voltage.

    b. Adjustable 0.5 to 6.0 second time delay to ride through normal source power outages (set at two seconds).

    c. Two auxiliary contacts to close on normal source failure (for remote alarm and engine start).

    d. Neutral (off) position adjustable time delay 0.1 to 60 seconds.

    e. Adjustable time delay on retransfer to normal (1 to 300 seconds). with 0-to-25-minute adjustable unloaded engine running time after retransfer.

7. Withstand ratings shall be the same rating as for the MCC but shall not be less than 65,000 amps AIC.

8. A maintained contact test auto switch and normal/emergency pilot lights shall be mounted on the door.

K. Automatic Transfer Switches (ATSs)

1. Automatic transfer switches shown on the Drawings as an integral part of the MCC shall be the voltage and rating shown. ATSs shall be three-pole for three phase three wire systems and four-pole for three phase four wire systems.

2. The switches shall initiate transfer of the load to the emergency source when any phase of the normal source drops below 80 percent of normal voltage.

3. The transfer switches shall be sized to carry full rated current on a continuous 24-hour basis without excessive heating or derating. The transfer equipment shall be capable of withstanding all available system fault currents without opening or damage the contacts during the fault clearing time of the transfer system over current protective device.

4. The transfer switches shall be double throw construction with three positions operation: closed to normal source, open, closed to emergency source. Time delay between opening of the closed contacts and closing of the open contacts shall be a minimum of 400 milliseconds to allow for load stabilization before transfer is complete.

5. ATS shall be the programmable logic controller (PLC) based type with a one-hour uninterruptible power supply (UPS), the mechanical equipment manufacturer shall furnish factory installed, a dedicated Point of Utilization Device (SPD) (Type 3), as specified in Section 26 43 13, Individual Control Panel and Related Equipment Protection.

6. The following accessories shall be furnished:

    a. Close differential adjustable phase sensing relay set to drop out at 80% of rated voltage and pick up at 90% of rated voltage.

    b. Adjustable 0.5 to 6.0 second time delay overriding normal source power outages (set at two seconds).

    c. Two auxiliary contacts to open on normal source failure.

    d. Two auxiliary contacts to close on normal source failure (for remote alarm and engine start).

    e. Neutral (off) position adjustable time delay 0.1 to 60 seconds.

    f. Adjustable time delay on retransfer to normal (1 to 300 seconds). [with 0-to-25-minute adjustable unloaded engine running time after retransfer.

7. Withstand ratings shall be the same rating as for the MCC, but shall not be less than 65,000 AIC.

8. A maintained contact test auto switch and normal/emergency pilot lights shall be mounted on the door.

L. Feeder Protective Devices (Non-Motor Loads)

1. Unless otherwise shown on the Drawings, feeder circuit breakers, 1200 ampere down to 250-ampere, shall be molded case, three-pole, 600-volt, fixed type, manually operated with stored energy closing mechanism. Trip device shall be solid state with adjustable long time pickup, adjustable instantaneous, adjustable ground fault pickup and delay; ground fault delay and pickup trips for selective tripping, and overload, short circuit and [ground fault] indicator lights. On breakers rated 1200 amperes, provide a remote energy-reduction maintenance switch with local indication connected to the instantaneous setting shall be provided to reduce the setting to minimum to reduce arc flash during equipment maintenance.

2. Unless otherwise shown on the Drawings, feeder circuit breakers, less than 250 ampere-frame, shall be molded case, three-pole, 600-volt, fixed type, manually operated with over-center toggle mechanism.

3. All circuit breakers shall have trip units of the modular type for easy changing of trip range.

4. All Main and Feeder circuit breakers shall have provision for padlocking in the OFF position.

M. Interlocks

1. Electrical, mechanical, and Kirk-Key interlocks shall be provided on breakers where shown on the Drawings.

2. Where Kirk-Key arrangements are used, the Kirk keyed interlocks shall be Kirk HD Series (Heavy Duty) 316 Series of 316 stainless steel or approved equal.

N. Control and Instrument Power Transformers.

1. Control power transformers shall be provided where shown on the Drawings. Transformer shall be sized for the entire load, including space heaters, plus 25% spare capacity. Provide a load calculation showing that the sizing of the control power transformer complies with this requirement.

2. Control power transformers shall be 120-volt grounded secondary. Primary side of the transformer shall be fused in both legs. One leg of the transformer secondary shall be solidly grounded while the other leg shall be fused.

3. Current transformers for power quality meters shall be instrument accuracy.

4. Protective relays and power quality meters shall not be on the same CT circuit.

5. All secondary CT circuits shall be landed on shorting type terminal blocks before proceeding to any other devices.

6. Differential relays shall have separate CTs.

O. Furnish lugs for incoming line feeders, sizes as shown on the Drawings. Allow adequate clearance for bending and terminating of cable size and type specified.

2.04 MOTOR CONTROLLERS

A. General

1. The Drawings indicate the approximate horsepower and intended control scheme of the motor driven equipment. Provide the NEMA size starter, circuit breaker trip ratings, control power transformers and thermal overload heater element ratings matched to the motors and control equipment supplied, in compliance with the NEC and the manufacturer's heater selection tables. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the Owner.

2. Motor starters shall be as shown on the Drawings. All motor starters shall be combination units, full voltage non-reversing (FVNR), with adjustable instantaneous trip magnetic only circuit breakers, or motor circuit protectors (MCP), unless otherwise specified or shown on the Drawings. NEMA starter sizes and breaker trip ratings shall be as required for the horsepower indicated but shall be in no case less than NEMA Size 1. If the manufacturer of the equipment utilizing the motor, supplies a motor horsepower larger than that shown on the Drawings, supply a motor starter sufficient in size to control the motor supplied. International (IEC) starters are not acceptable.

3. Each motor starter shall have a 120-volt operating coil unless otherwise noted.

4. NEMA Size 5 and smaller shall be draw out design with stab-on connectors engaging the vertical buses. Larger units shall be of the fixed (bolt-in) design.

5. Overload relays shall be standard Class 20, ambient compensated, manually reset by pushbutton located on front of the compartment door. A normally closed contact shall be directly used in the start circuit and a normally open contact shall be wire to a terminal board for overload alarm.

6. Control power transformers shall be 120-volt grounded secondary. Primary shall be fused with slow blow fuses in each phase. One leg of the transformer secondary shall be solidly grounded while the other leg shall be fused. The transformer shall be oversized for auxiliary loads as indicated on drawings, but in no case be smaller than 100 VA.

7. Combination starters shall include a motor circuit protector (MCP) in series with a motor controller and an overload protective device. The MCP shall have an adjustable magnetic trip range in percent of rated continuous current and a trip test feature. MCP's shall be labeled in accordance with UL489.

8. Where indicated on the Control Schematic title, motor starter logic shall be contained in a PLC with Ethernet Communications. The PLC shall not be affected by VFD frequency interference. The PLC shall be programmed by the manufacturer using the control schematics shown on the Drawings.

B. Magnetic Motor Starters

1. Motor starters shall be two or three pole, single or three-phase as required, 60 Hertz, 600 volt, magnetically operated, full voltage non reversing except as shown on the Drawings. NEMA sizes shall be as required for the horsepower shown on the Drawings. IEC rated starters are not acceptable.

2. Each motor starter shall have a 120-volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as shown on the Drawings. A minimum of one normally open and one normally closed auxiliary contacts shall be provided in addition to the contacts shown on the Drawings.

3. Overload relays shall be adjustable, ambient compensated and manually reset.

4. Control power transformers shall be sized for additional load of 100 VA or an additional 10% whichever is larger. Transformer primary shall be equipped with slow blow fuses. Control power transformers shall not be located behind other components and shall be accessible for removal or replacement without removing any other component.

5. Built in control stations and indicating lights shall be furnished where shown on the Drawings.

6. All wires shall be terminated on terminal blocks and shall be tagged.

7. The control compartment shall have a copy of the appropriate schematic and wiring diagram.

C. Combination Magnetic Motor Starters

1. Motor starters shall be a combination motor circuit protector and contactor, two or three pole, single or three-phase as required, 60 Hertz, 600 volt, magnetically operated, full voltage non reversing unless otherwise shown on the Drawings. NEMA starter sizes shall be as shown on the Drawings. If the motor supplied by the equipment supplier is larger than that shown on the Drawings, supply a larger starter size corresponding to the motor supplied. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall be current limiting type, with additional current limiters if required. IEC rated starters are not acceptable.

2. Each motor starter shall have a 120-volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as shown on the Drawings. A minimum of one normally open and one normally closed auxiliary contacts shall be provided in addition to the contacts shown on the Drawings.

3. Overload relays shall be adjustable, ambient compensated and manually reset.

4. Control power transformers shall be sized for additional load of 100 VA or an additional 10% whichever is larger. Transformer primary shall be equipped with time delay fuses.

5. Built in control stations and indicating lights shall be furnished where shown on the Drawings.

6. All wires shall be terminated on terminal blocks and shall be tagged.

7. The control compartment shall have a copy of the appropriate schematic and wiring diagram.

D. Multi-Speed and Reversing Starters

1. Multi speed and reversing starters shall include two motor rated contactors as described above, mechanically, and electrically interlocked so that only one device may be energized at any time.

E. Reduced Voltage Starters

1. Reduced Voltage Auto-Transformer Type Starters (RVAT).

a. Auto-transformer type with closed circuit transition. Auto transformers shall be dry type with 50%, 65% and 80% voltage taps and over temperature protection. Timing relays shall be electronic, adjustable. Relay settings shall be approximately 75% of relay range. Contactors shall be electrically and mechanically interlocked.

2. Reduced Voltage Solid State Type Starters (SSRV).

a. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass and output contactors, and electronic overload relay enclosed in a single molded housing.

b. The SCR-based power section shall consist of six back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV.

c. Units using triacs or SCR/diode combinations are not acceptable.

d. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects.

e. The logic board shall be accessible for testing, service, and replacement.

f. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformal coated to protect environmental concerns.

g. The paralleling run bypass contactor shall energize when the motor reaches 90% of full speed and close/open under one times motor current

h. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.

i. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads.

j. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter.

k. Starter shall have selectable overload class setting of 5, 10, 20 or 30.

l. Starter shall be capable of either an electronic or mechanical reset after a fault

m. Units using bimetal overload relays are not acceptable.

n. Over temperature protection (on heat sink) shall be provided.

o. Starters shall provide protection against improper line-side phase rotation. Starter shall shut down if a line-side phase rotation other than A-B-C exists. Provision for disabling shall be provided.

p. Starters shall provide protection against a phase loss or unbalance condition. Starter shall shut down if a 50% current differential between any two phases is encountered. Provision for disabling shall be provided.

q. Starter shall provide protection against a motor stall condition as standard. Provision for disabling shall be provided.

r. Starter shall provide protection against a motor jam condition as standard. Provision for disabling shall be provided.

s. Starter shall be provided with a Form C normally open, normally closed contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal and Overload)

t. The following control function adjustments on the device keypad are required:

    1) Selectable Torque Ramp Start or Current Limit Start

    2) Adjustable Kick Start Time: 0–2 seconds.

    3) Adjustable Kick Start Torque: 0–85%

    4) Adjustable Ramp Start Time: 0.5–180 seconds.

    5) Adjustable Initial Starting Ramp Torque: 0–85%

    6) Adjustable Smooth Stop Ramp Time: 0–60 seconds.

u. Maximum continuous operation shall be at 115% of continuous ampere rating.

v. Pump Control Option.

1) Provide control algorithm for pump start-up and shut down sequences. Control algorithm shall reduce the potential for water hammer in a centrifugal pump system. Upon a start command, the speed of the motor shall increase, under the control of the soft starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors shall close, and the pump shall run at design speed. Upon a stop command, the bypass contactors shall open, and the motor speed decreased in a tapered slope, to gradually slow the flow until the motor is brought to a stop. The start and stop ramp times shall be adjustable for the application requirements. The pump control option shall be factory installed.

3. Wye delta starters shall be closed circuit transition for use with 6 or 12 lead motors.]

F. Variable Frequency Drives (VFDs)

1. Fans shall be furnished for soft start starters and Variable Frequency Drives (VFDs), as required by the manufacturer, to provide air circulation and cooling and shall be as follows:

a. The fan shall operate only when the drive is “ON” and for a cool-down period after the drive has stopped. Otherwise, the fan shall not run when the drive is “OFF”. Louvers, if provided, shall have externally removable filters. The filter shall be metallic and washable.

b. Fan power shall be obtained from a tap on the main control power transformer.

c. A “loss of cooling” fault shall be furnished. In the event of clogged filters or fan failure, the drive shall produce an alarm and then, in a predetermined time, shut down safely without electronic component failure.

2. The VFD shall be a sinusoidal Pulse width modulated (PWM) type, with sensor-less Dynamic Torque Vector Control capability, designed for use with standard induction motors, constant or variable torque as required for the load application, with current limiting input fuses, incoming line reactors and/or active filters, circuit breaker disconnect, motor isolation contactor, control transformer overload relays and process signal follower card. Drives shall be UL listed. Variable frequency drives manufactured for HVAC applications are not acceptable.

3. The Drawings indicate the approximate horsepower and intended control scheme of the motor driven equipment. Provide the VFD, auxiliary components and equipment where shown or specified, and matched to the motors and control equipment supplied, in compliance with the NEC. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the Owner.

4. The VFD shall be sized for a motor one NEMA size larger than the motor being supplied.

5. The VFD inverter/chopper shall be of the pulse width modulated (PWM), neutral point clamp (NPC) type, converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Adjustable Current Source VFDs are not acceptable. The output devices shall be Insulated Gate Bipolar Transistors (IGBTs). Bipolar Junction Transistors, GTOs or SCRs are not acceptable.

6. Drive output voltage shall vary with frequency to maintain a constant volts/hertz ratio up to base speed (60 hertz) output. Constant or linear voltage output shall be supplied at frequencies greater than base speed (60 hertz).

7. The Drive shall be capable of a minimum of 100% rated current in continuous operation.

8. The drive one minute overload current rating shall be not less than 110% of rated current.

9. Each VFD shall have a thermal magnetic circuit breaker to provide a disconnect means. Operating handle shall protrude through the door. The disconnect shall not be mounted on the door. The handle position shall indicate ON, OFF, and TRIPPED condition. The handle shall have provisions for padlocking in the OFF position with at least three padlocks. Interlocks shall prevent unauthorized opening or closing of the VFD door with the disconnect handle in the ON position. Door handle interlock shall have provision for defeating by qualified maintenance personnel.

10. Where the cables from the VFD to the motor exceed 100 feet in length, a properly sized line reactor shall be installed at the VFD output to reduce dv/dt levels and the resultant peak voltage overshoots at the motor terminals.

11. Make provisions to accept a remote dry contact closure to start and stop the drive(s) with the drive control system in the AUTO mode.

12. Service Conditions

    a. Input power: MCC voltage plus 10%, minus 5%, three-phase, 60 Hertz.

    b. Input frequency: 57 to 63 Hz.

    c. Ambient temperature: 0 to 40°C (Enclosed).

    d. Elevation: Up to 3300 feet above mean sea level.

    e. Relative humidity: Up to 90% non-condensing.

13. Minimum Drive Efficiency: The VFD shall have an efficiency at full load and speed that exceeds 95% for VFDs below 15 HP and 97% for drives 15 HP and above. The efficiency shall exceed 90% at 50% speed and load.

14. Displacement Power Factor: 0.95 or better at any speed, measured at drive input terminals.

15. Drive Output: 100% rated current continuous, suitable for operation of the driven equipment over a 30:1 speed range without overloading or low speed cogging. Drives shall be capable of a continuous overload up to 110% rated current and a maximum 150% overload for one minute. Starting torque shall be matched to the load.

16. Voltage Regulation: plus or minus 1% of rated value, no load to full load.

17. Output Frequency Drift: No more than plus or minus 0.5% from setpoint.

18. Drives shall withstand five cycle transient voltage dips of up to 15% of rated voltage without an undervoltage trip or fault shutdown, while operating a variable torque load.

19. Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controller to any of the following conditions shall not result in component failure or the need for fuse replacement.

    a. Short circuit at controller output

    b. Ground fault at controller output

    c. Open circuit at controller output

    d. Input undervoltage

    e. DC bus overvoltage

    f. Loss of input phase

    g. AC line switching transients

    h. Instantaneous overload

    i. Sustained overload exceeding 115% of controller rated current

    j. Overtemperature responsive to a thermal switch in the motor or an overload relay

20. The controller electronics shall contain light emitting diodes (LED's) to monitor and indicate the following conditions.

    a. Under voltage

    b. Overvoltage

    c. Ground Fault

    d. Instantaneous Overcurrent

    e. Over temperature

f. Power UP Delay/Reset

g. Drive Enabled

h. Bus Capacitors Charged]

21. Where shown on the Drawings, furnish a three-contact or bypass, including a drive input disconnect, an VFD input isolation contactor, bypass contactor and an VFD output contactor that is electrically and mechanically interlocked with the bypass contactor. This circuit shall include control logic, status lights and motor over-current relays. The complete bypass system Hand-Off-Auto with Inverter-Bypass selector switch(s), and Inverter/Bypass pilot lights shall be packaged with the VFD. The unit shall be set up for Manual bypass operation upon an VFD trip.

22. Where shown on the Drawings, make provisions to accept a 4 20 mA DC input signal for remote speed control. Input shall be isolated at the drive and active with the drive control system in the AUTO mode.

23. Where shown on the Drawings, furnish a pneumatic process follower allowing motor speed control proportional to a 3-15PSIG pneumatic signal.

24. Where shown on the Drawings, furnish a 120 volts AC control to allow VFD to interface with remote dry contacts.

25. Where shown on the Drawings, furnish a motor over-current relay to provide sensing of a given level of load current.

26. Provide a 4 20 mA DC isolated output signal proportional to speed for remote speed indication.

27. Provide two sets of Form C auxiliary dry contacts for remote indication of VFD running status.

28. Provide two sets of Form C auxiliary dry contacts for remote indication of VFD fault.

29. Following an over or undervoltage trip, the drive shall automatically restart after a short time delay after the incoming line voltage is within the specified range.

30. The equipment manufacturer shall provide a harmonic analysis showing that the drives meet IEEE 519 at the Point of common Coupling. The Point of Common coupling shall be defined as the incoming line terminals of the motor control center. Total harmonic distortion shall be calculated under worst-case condition in accordance with the procedure outlined in IEEE Standard 519-1992. Copies of these calculations shall be submitted for approval. The worst-case condition of operation is defined as follows:

    a. All VFDs in the MCC are operating at full speed and all other loads on the MCC are in the “OFF” condition.

31. The voltage harmonic distortion, at the point of common coupling, shall not exceed 5% as indicated in Table 10.2 of IEEE 519.

32. The current harmonic distortion, at the point of common coupling, shall not exceed the limits in Table 10.3 of IEEE 519.

33. The harmonic analysis shall include all voltage and current harmonics to the 50th.

34. Each VFD shall, as a minimum, contain a 5%-line reactor. The manufacturer shall additionally use individual matrix filters, or an active harmonic filter on the MCC bus, as shown on the Drawings, for mitigating harmonic distortion. All VFDs of a single drive size shall have the same type and size of mitigating device. Other types of mitigation are not acceptable.

35. If the harmonic distortion does not meet the specified limits in the field tests, provide and install, at no additional expense to the Owner, additional filtering sufficient to meet IEEE 519 as specified. The manufacturer may substitute new VFDs containing matrix filters or an additional section on the MCC containing an active harmonic filter connected to the MCC bus, to meet the specified requirements. All VFDs of a single drive size shall still have the same type and size of mitigating device. Any Field modifications to the VFDs, their wiring, their enclosures, or relocation of cells in the MCC requiring motor or control conductor splicing to meet the specified requirements, will not be acceptable.

36. Compliance shall be verified with onsite field measurements of both the voltage and current harmonic distortion at the point of common coupling with operating conditions as defined above.

G. Harmonic Correction Units

1. Where Harmonic Correction Units are shown on the Drawings as an integral part of the MCC, the units shall be factory designed as a part of the MCC, for the attenuation of harmonics induced by nonlinear loads such as Variable Frequency Drives.

2. The harmonic correction unit shall be in a totally enclosed dead-front, free-standing MCC assembly. Structures shall be 90 inches high and 21 inches deep for front-mounted units. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus by metal barriers and shall be readily accessible through a hinged cover. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

3. An operating mechanism shall be mounted on the primary of each harmonic correction unit. It shall be mechanically interlocked with the door to prevent access unless the disconnect is in the “OFF” position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. Padlocking facilities shall be provided to positively lock the disconnect in the “OFF” position with from one to three padlocks with the door open or closed.

4. Harmonic Correction Units shall be disconnected from the power source by a molded case switch. All units shall include 200,000 AIC rated fuses with Class T actuation. All units shall be provided with a grounding lug. Grounding shall be provided according to local and national standards.

5. The harmonic correction units shall be sized to meet 5% total harmonic current distortion {THD (I)}, and <5% total harmonic voltage distortion {THD (V)} levels as defined by IEEE 519-1992 at the incoming line terminals of the VFD.

6. The harmonic correction unit shall be designed in accordance with the applicable sections of the following standards. Where a conflict arises between these standards and this specification, this specification shall govern.

    a. ANSI IEEE standard C62.41-1991 Surge Withstand Capacity

    b. CSA 22.2, No. 14 & 66 CSA requirements for power electronics

    c. FCC Part 15, Sub Part J, Class A RFI/EMI emission standards

    d. ANSI IEEE standard 519-1992 Harmonic limits

    e. UL 508C UL requirements for power conversion equipment

7. The motor control center manufacturer shall install the harmonic correction unit in the motor control center. The harmonic correction unit shall be approved by UL or CSA for installation in the motor control center.

8. Modes of Operation

    a. The harmonic correction unit shall be designed to electronically inject harmonic current to cancel load produced harmonic current such that the upstream power harmonic current and voltage are reduced to below 5% TDD and 5% THD (V) as defined by ANSI IEEE standard 519-1992 for load demand and voltage distortion limits. TDD refers to the total load demand of the applied circuit. The applied circuit may be a single nonlinear load, an entire distribution bus load, or the facility load at the Point-of-Common Coupling (PCC)

    b. Reactive current compensation (displacement power factor correction) shall be activated via a digital keypad/display mounted on the door of the enclosure. When reactive current compensation is activated, the harmonic correction unit shall first perform harmonic current correction and then use the remaining capacity to inject reactive current compensation to the specified level herein defined.

9. Design

    a. Each unit of the harmonic correction units shall meet FCC Part 15, Sub Part J Class A requirements for both radiated and conducted EMI.

b. All harmonic correction units shall be defined as a power electronic device consisting of power semiconductors that switch into the AC lines to modulate its output to cancel detrimental harmonic and/or reactive currents. A DC bus shall store power for power semiconductor switching. A microprocessor shall control the operation of the power converter.

c. Each unit shall be designed with a current limiting function to protect the semiconductors. When this level is attained, a message shall be displayed indicating the output capacity is at-maximum capacity and actuate the at-maximum capacity relay. Operation shall continue indefinitely at this level without trip off or destruction of the power correction unit.

d. Two distinct levels of faults shall be employed. Non-critical level faults shall provide automatic restart and a return to normal operation upon automatic fault clearance. Critical level faults stop the function of the unit and await operator action.

1) Faults such as ac line over-voltage, AC line under-voltage, AC line power loss, and AC line phase imbalance shall be automatically restarted. Upon removal of these fault conditions, the power correction system shall restart without Operator action. Automatic restart shall not occur if five faults have occurred in less than five minutes. During the fault condition, except line loss, the display shall state the type of fault and indicate that automatic restart will occur. The run relay and run LED shall be disabled. The fault relay shall not be enabled unless time out occurs. Upon AC line loss, the power-on relay shall be disabled, and no display shall be provided.

2) All other types of faults shall be considered critical and stop the power correction system. The display shall indicate the fault condition and “STOP.” The run LED and relay shall be disabled and the fault relay enabled. The Operator shall be required to initiate a power reset (turn power OFF and ON) to restart the power correction system.

e. The logic of the harmonic correction unit shall monitor the load current by utilizing two current transformers (CTs) mounted on phases A and B to direct the function of the power electronic converter. A third current transformer is required if single-phase or three-phase line-to-neutral connected loads are present downstream from the location of the CTs. The ratio of the CTs shall be entered into the logic via the digital keypad/display to calibrate the operation of the power correction system. The output of the current transformers shall be 5 amperes.

f. Up to three harmonic correction units may be installed in parallel to inject current according to the information received from one set of CTs. The units will function independently. If one unit is stopped or faulted, the remaining units will adjust accordingly to maintain optimum harmonic cancellation levels up to the capacity of the remaining units.

10. Performance Requirements

a. Input Power:

1) Voltage: Same as MCC service.

2) Voltage Tolerance: +/- 10% of nominal

3) Frequency: 60 Hertz, +/- 5%

4) Current Limit: 100% of rating

5) Surge Withstand Capability: ANSI/IEEE std. C62.41-1991 without damage.

11. Output Performance

a. Performance of the harmonic correction unit shall be independent of the impedance of the power source. All performance levels shall be attained whether on the ac lines or backup generator or output of the uninterruptible power supply (UPS)

b. Harmonic Correction:

1) Limit 2nd through 50th order harmonic current to <5% TDD as defined in ANSI/IEEE STD 519-1992 at each installed location. Harmonic levels for individual harmonic orders shall comply with respective levels established in ANSI/IEEE STD 519-1992.

2) Limit the THD (V) added to the electrical system immediately upstream of the power correction system location(s) to less than or equal to 5% as defined in ANSI/IEEE STD 519-1992. The power correction system shall not correct for utility supplied voltage distortion levels.

c. Reactive Current Compensation: to 0.95 lagging displacement power factor. Leading power factor is not permitted.

12. Environmental Conditions

a. The harmonic correction unit shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics or life.

1) Operating Ambient Temperature: 0 degrees C (32°F) to 40°C (104°F).

2) Storage Temperature: -40°C (-40°F) to 65°C (149°F).

3) Relative Humidity: 0 to 95%, non-condensing.

4) Altitude: Operating to 2000 meters (6500 feet). Derated for higher elevations.

5) Audible Noise: Generated by power correction system not to exceed 65 dbA measured one meter from surface of unit.

13. Current Transformers

a. Split core type current transformers shall be installed as defined herein and shown in the electrical drawings. Current transformers shall be rated for the total rated RMS current of the total load at each installed location.

b. Two current transformers per power correction system location shall be provided and shall be mounted on phases A and B. A third current transformer shall be provided if single or three-phase line-to-neutral connected loads are present downstream from the location of the CTs.

c. Each current transformer shall have a current output of five amperes. Current capacity of each current transformer shall be 5000, 3000, 1000 or 500, as required for the electrical system where installed. No other ratings are acceptable.

d. Each current transformer shall be rated for 400 Hertz.

e. The secondary of all current transformers shall be terminated on shorting type terminal blocks before connecting to any other device.

14. Operator Controls and Interface

a. All units shall include a digital interface model (DIM) that includes an alphanumeric display to clearly display information. All information shall be in English. Operators include run, stop, setup, enter, and up/down scroll.

b. The display shall provide operating data while functioning. Standard operating parameters available for display are ac line voltage, total RMS load current, harmonic current of load, reactive current of load, output harmonic and reactive current of power correction system.

c. When the output of the power correction unit is at full rated capacity, the display shall indicate at-maximum capacity and actuate an at-maximum capacity relay.

d. All fault conditions shall be displayed as they occur. Diagnostic information shall be provided in English and clearly indicate the nature of the fault.

e. The run pushbutton shall include a red LED. LED shall be lighted when unit is running.

f. Contacts shall be provided for operator information for power-on, run, fault and at-maximum capacity. Each contact shall be rated for one ampere at 120/240 volts. One Form C contact shall be provided for each relay.

15. An RS-485 serial communication port shall be provided for remote control and diagnostic information.]

H. Combination Contactors

1. Combination contactors shall be a circuit breaker and contactor, 600 Volt, three-pole, 60 Hertz, magnetically operated. NEMA size shall be as required for the kilowatt ratings shown on the Drawings but shall be not less than NEMA size 1.

2. Contactors shall have a 120-volt operating coil and control power transformer. Furnish the control power transformer with extra capacity for the unit heater fan.

3. Combination Contactors used for lighting control shall be as specified herein, magnetically operated, with the number of channels and poles as shown on the Drawings. Each contactor shall be controlled by an Astronomic Time Clock Tyco Model TC-100 or approved equal.

I. Control Relays

1. Control relays shall be 300-volt, industrial rated, plug-in socket type, housed in a transparent polycarbonate dust cover, designed in accordance with UL Standard 508 for motor controller duty. Continuous contact rating shall be 10 amperes resistive, 1/4 HP at 120 volts AC, operating temperature minus 10 to plus 55°C. Provide spare normally open and normally closed contacts. Relays shall be Potter & Brumfield KRP Series or equal with neon coil indicator light. Timing relays shall be 300-volt, solid state type, with rotary switch to select the timing range. Pneumatic timing relays are unacceptable.

2.05 METERING AND PROTECTIVE RELAYS

A. Where an elapsed time meter is specified or shown on the Drawings, a six-digit, non-resettable elapsed time meter shall be installed on the face of each motor starter. Meter shall be as specified in Section 26 27 12.

B. Furnish where shown on the Drawings, a Phase Protective Relay (PPR), as shown on the Drawings, and as specified in Section 26 27 12 Power Metering and Protective Relays.

C. Furnish where shown on the Drawings, a Motor Protection System (MP3), as shown on the Drawings, and as specified in Section 26 27 12 Power Metering and Protective Relays.

D. Furnish where shown on the Drawings, a Power Quality Meter (PM1), for each Main or Feeder Breaker, as shown on the Drawings and as specified in Section 26 27 12 Power Metering (PQM) and Protective Relays. Current transformers used on PQM shall be instrument accuracy.

E. All current transformers shall have their secondary conductors connected to shorting type terminal blocks before connecting to any other device.

F. Power Quality Meters and protective relays shall not both be connected to the same CT.

2.06 Markings – Hazard Warnings

A. Manufacturer shall provide Manufacturer's Markings as specified in NEC 110.16.

B. Manufacturer shall provide Field-Applied Hazard Markings according to NEC 110.21(B).

2.07 ACCESSORIES

A. Provide the following accessories.

1. Furnish and install a non-conducting switchboard floor mat, minimum 3/8-inch-thick by 3 feet wide, meeting ANSI/ASTM D-178-01 Type 2 Class 3, Wearwell 702 or equal, and extending the full length of the equipment lineup.

2.08 SPARE PARTS

A. Provide the following spare parts:

1. Three – Control fuses of type used.

2. One dozen each of cover bolts, spring nuts and door fasteners.

3. One quart or 12 aerosol cans of touch-up paint.

B. Spare parts shall be boxed or packaged for long term storage and clearly identified on the exterior of package. Identify each item with manufacturers name, description and part number.

2.09 FACTORY TESTING

A. The Motor Control Center shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer's routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.

B. Prior to factory testing, the manufacturer shall check to see that all selections and settings required by the Power System Study Engineer have been performed.

C. Factory test equipment and test methods shall conform with the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards.

D. The operational test shall include the proper connection of supply and control voltage and, as far as practical, a mockup of simulated control signals and control devices shall be fed into the boards to check for proper operation.

E. The manufacturer shall provide three certified copies of factory test reports as specified in Paragraph 1.03F.

PART 3 EXECUTION

3.01 MANUFACTURER'S REPRESENTATIVE

A. Provide the services of a qualified factory-trained manufacturer's field engineer to assist in installation and start-up of the equipment specified under this Section for a period of not less than two working days, with not less than one working day per motor control center. The manufacturer's field engineer shall provide technical direction and assistance in general assembly of the equipment, connections, and adjustments, and testing of the assembly and components contained therein.

B. Provide three copies of the manufacturer's field-testing report.

3.02 VARIABLE FREQUENCY DRIVES INSTALLATION

A. Provide the services of a manufacturer’s field engineer to assist in installation, adjusting, programming, startup, testing and training on the VFDs furnished and installed as a part of the MCCs.

3.03 INSTALLER’S QUALIFICATIONS

A. Provide an installer who shall be specialized in installing low voltage motor control centers with minimum five years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.04 EXAMINATION

A. Examine installation area to assure there is enough clearance to install the equipment.

B. Housekeeping pads shall be included for the motor control centers as detailed on the Drawings except for motor control centers which are to be installed adjacent to an existing unit. Housekeeping pads for these (if used) shall match the existing installation.

C. Check concrete pads and baseplates for uniformity and level surface.

D. Verify that the equipment is ready to install.

E. Verify field measurements are as instructed by manufacturer.

3.05 INSTALLATION

A. Install all equipment per the manufacturer’s recommendations and Contract Drawings.

B. Install required safety labels.

3.06 FIELD QUALITY CONTROL

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer’s instructions.

3.07 FIELD ADJUSTING

A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

B. The Power Monitoring and Protective Relays shall be set in the field by a qualified representative of the manufacturer, in accordance with settings designated in a coordinated study of the system as required in Section 26 05 74 Power System Study. All such settings, including the application of arc flash labels, shall have been made and Approved by the Owner/Engineer, prior to energizing of the equipment.

C. Return spare Kirk keys to the Owner after final acceptance.

3.08 FIELD TESTING

A. Provide a manufacturer's field engineer who shall make all electrical field tests recommended by the manufacturer. Disconnect all connections to solid-state equipment prior to testing.

B. Megger and record phase to phase and phase to ground insulation resistance of each bus section. Megger, for one minute, at minimum voltage of 1000 volts DC. Measured Insulation resistance shall be at least 100 megohms. In no case shall the manufacturer's maximum test voltages be exceeded.

C. Complete the following test forms:

1. Motor Control Center Test Report: Before energizing the motor control center, perform megohm meter tests. The measurements shall be made on all phase busing and the data checked for conformance with typical manufacturer's data. The tests shall adhere to manufacturer's testing recommendations for the proper testing methods and test voltage levels for each piece of equipment. Readings that fall below manufacturer's recommended values will not be acceptable. Provide any necessary remedial action before the busing is energized. A data sheet and test report shall be submitted to the Owner/Engineer for each MCC and shall be reviewed and approved prior to energization of the MCC. The test report shall include the following equipment information:

   a. MCC (SB or PNL) Name and number:

   b. MCC (SB or PNL) manufacturer

   c. MCC (SB or PNL) Nameplate data:

      1) Volts:

      2) Horizontal bus amps:

      3) Main breaker amps:

   d. Insulation test (measured):

      1) Phase A-B:

2) Phase B-C:

3) Phase C-A:

4) Phase A-G:

5) Phase B-G:

6) Phase C-G:

e. Equipment disconnected during test:

f. Date of test:

g. Tested by:

D. Test reports showing unsatisfactory results may require the removal of all defective or suspected materials, equipment and/or apparatus, and their replacement with new items as determined by the Owner/Engineer with no change in the Contract Price or Schedule allowed. Retesting, if required by the Owner/Engineer shall be done with no change in Contract Price or Schedule.

E. Test each key interlock system for proper functioning.

F. The manufacturer's field engineer shall perform field measurements, of both the voltage and current harmonic distortion at the point of common coupling with operating conditions to determine compliance with the Specifications.

3.09 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.10 EQUIPMENT PROTECTION AND RESTORATION

A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.11 MANUFACTURER'S CERTIFICATION

A. Provide a qualified factory-trained manufacturer's representative who shall personally inspect the equipment at the jobsite and shall certify in writing that the equipment has been installed, adjusted, and tested, in accordance with the manufacturer's recommendations, including all settings designated in the Power System Study.

B. Provide three copies of the manufacturer's representative's certification.

3.12 TRAINING

A. Provide manufacturer's services for training of plant personnel in operation and maintenance of the equipment furnished under this Section.

B. The training shall be for a period of not less than one eight-hour day.

C. The cost of training program to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied.

D. Provide detailed O&M manuals to supplement the training course. The manuals shall include specific details of equipment supplied and operations specific to the project.

E. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, motor starters, protective devices, metering, and other major components.

F. The Owner reserves the right to videotape the training sessions for the Owner’s use.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install panelboard(s) as specified herein and as shown on the Drawings.

B. The provisions of this Section shall apply to all panelboards, except as indicated otherwise.

1.02 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted. Manufacturer's cut sheets and catalog data

3. Breaker arrangement

4. Breaker characteristic curves

5. Instruction for handling and storage

6. Installation instructions

7. Dimensions and weights

B. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

C. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 26 05 74. Submittals made prior to such approval will be returned unreviewed.

D. Provide systems engineering to produce coordination curves, showing coordination between existing and/or new breakers and/or fuses submitted, such that protective device coordination is accomplished. Such curves and settings shall be included as a part of these submittals.

E. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

F. Shop Drawings and Product Data. The following information shall be submitted to the Engineer:

1. Master drawing index
2. Front view elevation
3. Top view
4. Nameplate schedule
5. UL Listing of the completed assembly
6. Conduit entry/exit locations
7. Assembly ratings including:
    a. Short-circuit rating
    b. Voltage
    c. Continuous current
8. Major component ratings including:
    a. Voltage
    b. Continuous current
    c. Interrupting ratings
9. Descriptive bulletins
10. Product data sheets.
11. Cable terminal sizes.

G. Operation and Maintenance Manuals.

1. Operation and maintenance manuals shall include the following information:

a. Manufacturer's contact address and telephone number for parts and service.

b. Instruction books and/or leaflets

c. Recommended renewal parts list

d. Record Documents for the information required by the Submittals paragraph above.

1.04 REFERENCE CODES AND STANDARDS

A. The low voltage panelboard assembly and all components in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

B. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA AB1: Molded Case Circuit Breakers

2. NEMA PB1: Panelboards

3. NEMA PB1.1: Instruction for Safe Installation Operation and Maintenance of Panelboards rated 600 volts or less.

4. NEMA PB1.2: Application Guide for Ground-fault Protective Devices for Equipment

5. UL 67: Panelboards

6. UL 50: Cabinets and Boxes

C Federal Specifications, FS W-C-375A: Circuit Breakers, Molded Case, Branch Circuit and Service.

1. Fed. Spec W-P-115C

D American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Article 408 - Switchboards and Panelboards.

1.05 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer. Equipment that is manufactured by a third party and "brand labeled" shall not be acceptable.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

E. The equipment submitted shall fit within the space shown on the Drawings. The equipment shall not be acceptable otherwise.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at time of shipment and shall be made available to the Contractor and Owner. The instructions shall include detailed assembly instructions including but not limited to wiring interconnection diagrams, rigging for lifting, skidding, jacking, and moving using rolling equipment to place the equipment, bolt torquing requirements for bus and all other components which require the installation of bolted connections, and instructions for storing the equipment prior to energizing.

C. Equipment shall be stored indoors and protected from moisture, dust and other contaminants.

D. Equipment shall not be installed until the location is finished and protected from the elements.

1.07 WARRANTY

A. Provide warranties, including the manufacturer’s warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for three years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner. .

1.08 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable.

1. ABB
2. Eaton
3. Schneider Electric Co
4. Siemens
5. No equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

A. The service voltage, overall short circuit withstand, and interrupting rating of the equipment and components shall be as shown on the Drawings, except that the minimum interrupting rating shall be 22,000 amperes RMS symmetrical for 240/120 volt single- phase or 208Y/120 volt three-phase. The minimum interrupting for 480Y/277 volt three-phase shall be 65,000 amperes RMS symmetrical. Panelboards employing series connected ratings for main, feeder and branch devices are not acceptable and shall not be provided.

B. Panelboards shall be UL listed and labeled as suitable for use as service equipment.

C. Where the panelboard is shown or specified to contain a surge protective device (SPD), the complete panelboard, including the SPD, shall be UL67 listed.

D. Panelboards shall be designed for continuous operation, at rated current, in a 40°C ambient.

E. For additional ratings and construction notes, refer to the Drawings.

2.03 CONSTRUCTION

A. General

1. Refer to the Drawings for actual layout and location of equipment and components, and other required details.
2. Provide panelboards manufactured and tested in accordance with NEMA PB 1.
3. Provide circuit breakers of industrial grade, manufactured and tested in accordance with NEMA AB 1 and Federal Specification FS W-C-375.
4. Perform a load analysis to assure the panel rating is not overloaded when new loads are added to existing panels.

5. A nameplate shall be provided listing manufacturer's name, panel type and rating. Nameplates shall be engraved, laminated impact acrylic, matte finish, not less than 1/16-inch thick by 3/4-inch by 2-1/2-inch, Rowmark 322402, or equal. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X 1/2 inch, or equal. Prior to installing the nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues has been removed. Epoxy adhesive or foam tape is not acceptable.

B. Enclosures

1. General

a. Each enclosure shall be provided with a legend pocket on the inner door.

b. Enclosures shall not have holes or knockouts.

2. NON-METALLIC

a. Chemical Rooms. NEMA 4X constructed as follows:

1) PVC or Fiberglass reinforced polyester body and door.

2) UV inhibitors

3) Luggage type quick release latches

4) Foam-in-place gasketed doors

3. ALUMINUM

a. NEMA 4X Aluminum

1) Type 5052 aluminum, body and door

2) Stainless steel hinge pins

3) Foam in-place gasket

4. NEMA 12

a. NEMA 12 Steel

1) Mild Steel body and door

2) Stainless steel hinge Pins

5. Not otherwise Defined.

a. Where an enclosure is not otherwise defined or shown on the Drawing

1) NEMA 4X Stainless Steel

2) Type 316 stainless steel, body and door

3) Stainless steel hinges

4) Foam in-place gasket

6. NEMA 1 or NEMA 1A

a. Where installed indoor with air conditioner space shown on the Drawing

1) Mild Steel body and door

2) Stainless steel hinge Pins

C. Surge Protective Devices (SPDs)

1. Panelboards shown or specified to include an SPD, shall include a Type 2 SPD manufactured by the same manufacturer of the panelboard. Refer to Section 26 43 13 for specifications of the SPDs, and the required submittals to be included under this Section. Submittals not containing the required information in Section 26 43 13 will be returned un-reviewed.

2. The SPD shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs. The SPD shall be interfaced to the panelboard via a direct bus bar connection. The SPD shall be located within the panelboard, unless otherwise shown on the Drawings.

3. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options. See Section 26 43 13 for additional requirements.

D. Exteriors

1. Unless otherwise noted, all panels shall be designed for surface mounting.

2. Hinged doors covering all circuit breaker handles shall be provided on all panels.

3. Doors shall have semi flush type cylinder lock and catch, except that doors over 48 inches in height shall have a vault handle and three-point latch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.

E. Interiors

1. At least four studs for mounting the panelboard interior shall be furnished.

2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling, or tapping.

3. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper wire of the sizes indicated.

F. Busses

1. All busses, including neutral busses and ground bars, shall be of tin-plated copper. Neutral busses shall be full size. Phase bussing shall be full height without reduction. Cross connectors shall be tin plated copper.

2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

4. Equipment ground bars, of tin-plated copper, shall be furnished.

5. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

2.04 CIRCUIT BREAKERS

A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.

B. Circuit breakers shall be molded case, bolt-on type.

C. Each circuit breaker used in 208Y/120-volt, three phase, or 120/240-volt single phase, panelboards shall have an interrupting capacity of not less than 22,000 amperes, RMS symmetrical.

D. Each circuit breaker used in 480Y/277 volt and 480-volt panelboards shall have an interrupting capacity of not less than 65,000 amperes, RMS symmetrical.

E. Provide ground fault interrupters with trip rating where shown on the Drawings.

F. Circuit breakers shall be as manufactured by the panelboard manufacturer.

2.05 MINI-POWER CENTERS

A. Mini-power centers shall include a main primary breaker, a dry-type transformer and circuit breaker-type load center in a common NEMA 3R 316 stainless steel enclosure, suitable for indoor/outdoor operation.

B. kVA and voltage ratings shall be as shown on the Drawings. Main primary breaker shall have an interrupting rating of 65,000 amperes at 480Y/277 volts and a secondary load center rated at 14,000 amperes interrupting capacity (AIC) RMS symmetrical at 120/240 or 208Y/120 volts as shown on the drawings. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

1. Up to 9 KVA 40 dB

2. 10 to 30KVA 45 dB

C. Transformer shall be copper wound, 220°C insulation system with a maximum full load temperature rise of 115°C rise. Transformers shall be epoxy-resin encapsulated. The core of the transformer shall be grounded to the enclosure with the neutral wired out to a neutral bus and bonded to a ground bus inside the transformer enclosure. Provide two 5% FCBN taps. All interconnecting wiring between the primary breaker and transformer, secondary main breaker and transformer and load center shall be of copper and factory installed.

D. Power center shall have phase, neutral and ground tinned copper buses, and be complete with all circuit breakers as shown on the drawings. Breakers shall have an interrupting rating of 10,000 amperes minimum, and shall be of the bolt-on type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount boxes for surface mounted panelboards so there is at least 1/2-inch air space between the box and the wall.

B. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses.

C. Type circuit directories giving location and nature of load served. Install circuit directories in each panelboard.

END OF SECTION

SECTION 26 27 12
ELECTRICAL POWER METERING AND PROTECTIVE RELAYS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section of the Specifications describes the requirements for power metering and protective relays to be furnished under other Sections of the Specifications to which reference is made in the Related Work paragraph of this Section.

B. All equipment described herein shall be submitted and furnished as an integral part of equipment specified elsewhere in these Specifications.

1.02 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

B. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 26 05 74. Submittals made prior to such approval will be returned unreviewed.

C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

D. Submit catalog data for all items supplied from this specification Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc., enough to confirm that the meter or relay provides every specified requirement. Any options or exceptions shall be clearly indicated.

E. Operation and Maintenance Manuals.

1. Operation and Maintenance manuals shall include the following information:

    a. Manufacturer's contact address and telephone number for parts and service.

    b. Instruction books and/or leaflets

    c. Recommended renewal parts list

    d. Record Documents for the information required by the Submittals above.

1.04 REFERENCE CODES AND STANDARDS

A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NEMA/ISCI – 109 Transient Overvoltage Withstand Test

2. IEEE Std. 472/ANSI C37.90A Surge Withstand Capability Tests

3. IEC 255.4 Surge Withstand Capability Tests

B. All meters, relays and associated equipment shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.

C. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.05 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Equipment submitted shall fit within the space or location shown on the Drawings. Equipment which does not fit within the space or location is not acceptable.

C. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.06 WARRANTY

A. Provide warrantees, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner

1.07 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 GENERAL

A. Metering and Protective Relay Enclosures

1. Enclosures for meters and protective relays located within the associated equipment shall have the same Enclosure Types as specified for the associated equipment.

B. Settings

1. Refer to Section 26 05 74 Power System Study for relay settings.

2. Control and Instrument Power Transformers

a. Control power transformers shall be furnished as shown on the Drawings. Transformer mechanical ratings shall equal the BIL and momentary rating of the circuit breakers. Transformers, when mounted in switchgear assemblies, shall be rated for the full voltage of the switchgear. Transformer shall be sized for the entire load, including space heaters, plus 25% spare capacity, and shall be not less than 100 VA. Provide a load calculation showing that the sizing of the control power transformer complies with this requirement.

b. All control power transformers shall have vacuum cast primary and secondary coils using epoxy resin. Voltage and control power transformers of the quantity and ratings indicated. Control power transformers shall be 120 volts grounded secondary. Primary side of the transformer shall be fused in both legs. One leg of the transformer secondary shall be solidly grounded while the other leg shall be fused.

3. Current Transformers

a. Current transformers shall be furnished as indicated on the contract drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. The location for the current transformers shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections.

b. Current transformers for power quality meters shall be instrument accuracy. Meters and relays shall not be placed on the same current transformer circuit. Provide separate current transformers for relays and for meters.

c. Provide separate current transformers for differential relays shown on the drawings.

d. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

2.02 MOTOR PROTECTION SYSTEM (MP3)

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Multilin 869

2. No equal The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Minimum ANSI Functions

ANSI Function	**Description**	**Setting**
14	Speed Switch	Enabled
19	Reduced Voltage Start	Enabled
27	Under voltage	<85%
32	Jam/Acceleration	Enabled
37	Undercurrent/Under voltage	Per motor vendor recommendation
38	Bearing Temperature	Enabled
46	Current Unbalance	Enabled
47	Voltage Unbalance / Phase Reversal / Phase Failure	Enabled
49	Stator Temperature	Enabled
50	Instantaneous Current	According to protective device coordination study
50G	Instantaneous Ground Current	According to protective device coordination study
51	Overcurrent	According to protective device coordination study
51G	Ground Overcurrent	According to protective device coordination study
55	Power Factor	Enabled
59	Overvoltage	>115%
66	Starts per Hour	Set in field per manufacturer requirements
81	Frequency	<59.5 Hz; >60.5 Hz
86	Overcurrent Lockout	Enabled
87	Differential Protection	Enabled

C. General

1. All circuit boards shall have a harsh environment conformal coating to resist H_2S gas and other corrosive agents, including humidity.

D. Protection and Control

1. Thermal model biased with RTD and negative sequence current feedback
2. Start supervision and inhibit
3. Locked rotor / mechanical jam
    a. The relay shall protect the rotor during stall and acceleration. The stall/acceleration curve shall be voltage compensated and a speed switch input shall be available. The stator protective thermal model shall combine inputs from positive and negative sequence currents and RTD winding feedback. The model shall be dynamic in nature in order to follow the loading and temperature of the motor.
4. Voltage compensated acceleration
5. Under voltage, overvoltage
6. Under frequency
7. Stator differential protection
    a. Differential protection using CT inputs (6) from both sides of the machine winding Voltage transformer inputs shall be used to provide over voltage, under voltage, voltage phase reversal, over frequency and under frequency functions.
8. Thermal overload
9. Over temperature 12 RTD’s
10. Phase and ground overcurrent
11. Current unbalance
12. Power Elements
    a. Power factor
    b. Reactive power
    c. Under power
    d. Reverse active power
    e. Over torque

13. Torque protection

14. Reduced voltage starting control

E. Monitoring and Metering

1. Metering Functions

a. A, V, W, Var, VA, PF, Hz, kWh, VARh, and kW demand

b. The system shall include complete power metering. An event record shall store the last 40 events. Sixteen cycles of waveform data shall be stored each time a trip occurs. A simulation feature shall be available for testing the function.

2. Torque, temperature

3. Event recorder

4. Oscillography and data logger

5. Statistical information and learned motor data

6. Motor starting reports

F. Inputs and Outputs

1. 12 RTDs, programmable

2. Five predefined and four assignable digital inputs

3. Six output relays

4. Four analog inputs

5. Four programmable analog outputs

G. Memory

1. Memory shall be non-volatile, and programming shall remain intact upon power failure.

2. Interface software shall be provided in a Windows® format.

H. User Interface

1. A 40-character LCD display and associated keypad to provide access to actual values and set points.

I. Control Power:

1. Range of available control power: DC: 90-300 VDC; AC: 70-265 VAC, 48 to 62 Hz.

2. LO Range: DC: 20-60 VDC; AC: 20-48 VAC, 48 to 62 Hz.

J. Communication

1. For remote monitoring, the following communication ports shall be provided:

   a. One Industry Standard port for meter and relay programming using a laptop computer.

   b. One RS-485 port.

   c. One integral 10/100BaseT Ethernet port. The connection shall support Modbus TCP, Ethernet IP and SNMP. Where an integral port is not available, provide a media protocol converter as specified herein.

   d. The manufacturer shall factory enter the proper IP Address for such connection. Upon request by the Contractor, the Owner/Engineer will provide the proper Internet Protocol Address (IP Address), to be configured by the equipment manufacturer.

2. The protocol interface shall implement Ethernet/IP Protocol with the following as minimum capabilities:

   a. Transfer of basic I/O data via User Datagram Protocol (UDP)-based implicit messaging.

   b. Uploading and downloading of parameters, set points, programs and recipes via TCP (i.e., explicit messaging.)

   c. Polled, cyclic and change-of-state monitoring via UDP, such as RPI and COS in Allen Bradley's Control Logix control systems.

   d. One-to-one (unicast), one-to-many (multicast), and one-to-all (broadcast) communication via TCP

   e. Use of well-known TCP port number 44818 for explicit messaging and UDP port number 2222 for implicit messaging.

   f. All data shall be available and/or mirrored within the Modbus 4x or "Holding Register" memory area.

   g. Register 4x00001 shall exist and be readable to allow simple, predictable "comm tests".

   h. Software tools shall function properly with slaves' only supporting Modbus functions 3, 4 and 16. Requiring support of diagnostic function 8 is not acceptable.

   i. Software tools shall be configurable to write a single register as either function 6 or 16.

j. Software tools shall allow setting the Modbus/TCP "Unit Id" to be a value other than zero. This is required for Ethernet-to-Serial bridging.

3. The media protocol converter shall meet the following criteria:

a. The converter shall support 10/100Base-T Ethernet. The serial port speed (baud rate) shall support 230kbps. The protocol shall support Modbus TCP, Ethernet IP, DF1, and Modbus RTU/ASCII. Protocol shall be Web Browser configurable.

b. Operating limits shall be 0-60°C, with humidity range minimum of 5-90%. Shock capability on the serial port shall be ESD +15 kV air GAP meeting IEC 1000-4-2. Power requirements shall be 9-30VDC at 0.5A minimum.

c. The converter shall have LED status for serial, signals, power, and Ethernet.

d. The converter housing shall be UL 1604, Class 1 Div 2, DIN Rail mountable. The converter shall have DB-9M port connection, with screw terminals, to the input.

e. Converter shall be Digi One IAP or approved equal.

2.03 POWER QUALITY METER (PM1)

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. GE Multilin PQMII Power Quality Meter

2. Approved equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. General

1. All circuit boards shall have a harsh environment conformal coating to resist H_2S gas and other corrosive agents, including humidity.

D. Monitoring and Metering

1. Metering Functions with accuracy of 0.2% for A & V and 0.4% for power parameters

a. A, V, VA, W, VAR, KWH, KVARH, KVAH, PF, Hz

b. W, VAR, A, VA Demand

c. A, V Unbalance

2. Power Analysis Functions.

a. Total Harmonic Distortion

b. Individual harmonics

c. Waveform capture

d. Historical data

e. Minimum and maximum metered values complete with time and date

f. Record of last 40 events

g. Two independent data logs

E. User Interface and Programming

1. Integrated keypad to access actual values and set points.

a. 2 - line, 40 character illuminated display for use with keypad. The display shall have:

1) Variable scrolling rates.

2) Front mounted LEDs to display alarms, communication status, relay status, simulation mode, self-test failure, and set point access status.

3) Relay reset button to clear alarm and auxiliary conditions.

2. The meter shall have one alarm output relay with Form C contacts.

3. Relay output shall be through alarm, auxiliary and pulse output functions.

4. The meter shall provide a user configurable pulse output based on KWH, KVARH or KVAH.

5. The meter shall provide a pulse input for demand synchronization.

6. The meter shall include a simulation mode capability for testing the functionality and meter response to programmed conditions without the need for external inputs.

7. The relay shall include a power systems option consisting of harmonic analysis, triggered trace memory waveform capture, event record and data logger functions.

F. Control Power:

1. Range of available control power: DC: 88-300 VDC; AC: 70-265 VAC, 48 to 62 Hz.

2. LO Range: DC: 20-60 VDC; AC: 20-48 VAC, 48 to 62 Hz.

G. Communication

1. For remote monitoring, the following communication ports shall be provided:

    a. One Industry Standard port for meter and relay programming using a laptop computer.

    b. One RS-485 port.

    c. One integral 10/100BaseT Ethernet port . The connection shall support Modbus TCP, Ethernet IP and SNMP. Where an integral port is not available, provide a media protocol converter as specified herein.

    d. The manufacturer shall factory enter the proper IP Address for such connection. Upon request by the Contractor, the Owner/Engineer will provide the proper Internet Protocol Address (IP Address), to be configured by the equipment manufacturer.

2. The protocol interface shall implement Ethernet/IP Protocol with the following as minimum capabilities:

    a. Transfer of basic I/O data via User Datagram Protocol (UDP)-based implicit messaging.

    b. Uploading and downloading of parameters, set points, programs and recipes via TCP (i.e., explicit messaging.)

    c. Polled, cyclic and change-of-state monitoring via UDP, such as RPI and COS in Allen Bradley's Control Logix control systems.

    d. One-to-one (unicast), one-to-many (multicast), and one-to-all (broadcast) communication via TCP

    e. Use of well-known TCP port number 44818 for explicit messaging and UDP port number 2222 for implicit messaging.

    f. All data shall be available and/or mirrored within the Modbus 4x or "Holding Register" memory area.

    g. Register 4x00001 shall exist and be readable to allow simple, predictable "comm tests".

    h. Software tools shall function properly with slaves' only supporting Modbus functions 3, 4 and 16. Requiring support of diagnostic function 8 is not acceptable.

    i. Software tools shall be configurable to write a single register as either function 6 or 16.

    j. Software tools shall allow setting the Modbus/TCP "Unit Id" to be a value other than zero. This is required for Ethernet-to-Serial bridging.

3. The media protocol converter shall meet the following criteria:

    a. The converter shall support 10/100Base-T Ethernet. The serial port speed (baud rate) shall support 230kbps. The protocol shall support Modbus TCP, Ethernet IP, DF1, and Modbus RTU/ASCII. Protocol shall be Web Browser configurable.

    b. Operating limits shall be 0-60°C, with humidity range minimum of 5-90%. Shock capability on the serial port shall be ESD +15 kV air GAP meeting IEC 1000-4-2. Power requirements shall be 9-30VDC at 0.5A minimum.

    c. The converter shall have LED status for serial, signals, power, and Ethernet.

    d. The converter housing shall be UL 1604, Class 1 Div. 2, DIN Rail mountable. The converter shall have DB-9M port connection, with screw terminals, to the input.

    e. Converter shall be Digi One IAP or approved equal.

2.04 PHASE FAILURE RELAY (PFR)

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Taylor Phase-Guard Model P

2. Approved equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. Protection

1. Indicators - LED

    a. Normal – Green.

    b. Phase loss or Low Voltage – Yellow.

    c. Reverse Phase – Red.

2. Enclosure

    a. As required in accordance with the Area Classification and Enclosure Types specified herein.

3. Functions.

    a. Automatic Reset

    b. Phase Loss.

1) 12% or more.

2) Delay 1-1/2 seconds.

c. Low Voltage Protection

1) Drop at 70% of normal

2) Reset at 90% of normal

d. Time Delays

1) Adjustable

e. Over Voltage Protection

1) Greater than 15%

2) Reset at 5% greater than normal

2.05 LOAD CURRENT MONITORING TRANSDUCER

A. Where a load monitoring current transducer is shown on the drawings or specified, provide a solid core or split core CT with an integral current transducer which accepts a 0-to-5-amp input from the CT and provides a 4-20 milliamp DC current output.

B. Transducers monitoring non-sinusoidal loads associated with variable frequency drives (VFD) or silicon-controlled rectifier (SCR) applications shall have a built-in mathematical algorithm that integrates the wave form over time to produce a true RMS output.

C. The CT primary shall be selected based on the full load rating of the load that is being monitored. The transducers shall be UL listed.

D. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Automation Direct.

2. Approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. All equipment specified herein shall be factory installed, field adjusted, tested, and cleaned as an integral part of equipment specified elsewhere in these Specifications. All current transformers shall have their leads terminated on shorting type terminal blocks before continuing to any other devices.

B. Enclosure Mounting Requirements:

1. Meters and relays integral to MCC

    a. Meters and relays shall be mounted integral to the MCC as shown or specified, unless specified or shown to be mounted in separate enclosures.

2. Separately mounted meters and relays

    a. Separately mounted relays and meters shall be mounted in enclosures meeting the requirements of Section 26 05 33 Raceways, Boxes, Enclosures and Fittings.

    b. Mount all separately-mounted enclosures with an air gap between the enclosure and wall or mounting plate. Create the air space with slotted channel or several stainless-steel washers which together will make at least a ¼-inch space.

    c. Provide integral welded on mounting feet for floor mounted enclosures.

    d. Provide all enclosures with integral welded-on mounting lugs and use only the integral mounting lugs to mount the enclosure. Drilling through the back of any enclosure to provide a mounting means is prohibited. Any enclosure drilled to provide a mounting means will be rejected and shall be replaced with no change in Contract Time or Price even if the enclosure installation is complete with raceway attached and conductors installed.

    e. Penetrations in any enclosures with a NEMA 3R, 4 or 4X rating which is located in any wet or damp area or in any process area whether it appears to be dry or not shall be in the sides or bottom only. Top penetrations in any enclosure located as described herein shall not be done for any reason, including raceway entries or equipment mounting. Top penetrations by the Contractor or by the original equipment manufacturer in the factory are all prohibited. Any enclosure with a top penetration located in the areas specified will be rejected and shall be removed and replaced, even if it requires a return to the factory. Raceway penetrating the top shall be re-routed and re-installed. All installed conductors in re-routed raceway shall be removed and re-routed in the re-routed raceway. Conductors found to be too short to be re-terminated shall be removed back to their source or load as the case may be and shall be replaced. Splicing is prohibited and unacceptable. All specified corrective measures shall be provided with no change in Contract Time or Price.

END OF SECTION

SECTION 26 27 16
ELECTRICAL CABINETS AND ENCLOSURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for cabinets and enclosures for housing of control panels and motor controls.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

1. 250 - Enclosures for Electrical Equipment (1000 volts maximum).

a) NEMA 3 - Enclosures for outdoor use primarily to provide a degree of protection against wind-blown dust, rain, and sleet; undamaged by formation of ice on the enclosure.

b) NEMA 12 - Enclosures for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids.

c) Provide NEMA 4X 316 Stainless Steel enclosures for outdoor and wet locations or as specified on drawings.

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 312 - Cabinets, Cutout Box, and Meter Socket Enclosures.

C. Underwriters Laboratories (UL), UL 50 - Safety for Cabinets and Boxes.

1.03 SUBMITTALS

A. Submit the following under provisions of Division 1 and Section 26 05 01 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data

2. Instruction for handling and storage

3. Installation instructions
4. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Have cabinets and enclosures packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. The EMF Company

B. Hennessey Products, Inc.

C. Hoffman Industrial Products

D. Pauluhn Electric Manufacturing Company

E. Weigman Company

F. Rose Enclosure

G. N.E.M.A. Enclosure Mfg. Co.

H. Rittal

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes

1. Provide enclosures manufactured in accordance with NEMA 250 and NEC Article 312. Fabricate outdoor NEMA 3 panels from 0.125- inch thick type 5052 H32 aluminum or 14 gauge, 316 stainless steel for installation in areas that are not air conditioned. NEMA 12 indoor panels for installation in air conditioned areas shall be painted steel.

2. Dimensions and special features are shown on the Drawings.

3. Construct outdoor enclosures with continuously welded seams ground smooth.

4. Additional material thickness and bracing requirements shall be determined by the manufacturer to provide the strength required by the standard listed. The bracing shall be provided in such a way as to minimize the protrusion into the wiring and the equipment spaces.

5. Install the door with a stainless steel continuous hinge, stainless steel padlock handle with gasket and stainless steel hardware. Junction boxes shall be mounted so the door opens to the right or to the left.

6. Furnish the door with oil-resistant neoprene gasket attached with oil-resistant adhesive and held in place with aluminum retaining strips.

7. Use a single, 3/4-inch minimum, door handle that provides a 3-point latching through latch rods with rollers. Provide rollers with at least 3/4-inch diameter.

8. Gasketed overlapping doors may be used instead of a center post.

9. Provide heavy duty lifting eyes of suitable material.

10. Fabricate the enclosure with a stud-mounted panel inside. Make panels from 12-gauge steel painted with white enamel finish.

11. Equip both NEMA 12 and NEMA 3 enclosures with thermostatically controlled space heaters and corrosion inhibitors. Provide heaters rated for 240V for 120V operation.

12. Weld mounting feet to the enclosure if called for on the Drawing.

13. Include a high impact plastic data pocket in the enclosure.

14. Provide ground connections on the enclosures to enable grounding of the enclosure with a No. 2 AWG conductor.

15. Equip free-standing outdoor cabinets with inner and outer door restraint bars to prevent door swing during windy conditions.

16. Supply indoor enclosures with filtered passive air intake and exhaust openings, 4-inch square in the side near the top and near the bottom of the adjacent side panel.

B. Hardware

1. Mounting Hardware: Stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

2.03 TESTING

A. Test cabinets and enclosures in accordance with UL 50 so unit qualifies for a UL label.

PART 3 EXECUTION

3.01 PREPARATION

A. Review Drawings and determine how many enclosures of each kind are required and check if supplied quantity is sufficient.

B. Check the mounting pads or foundations for proper mounting dimensions and features, including grounding conductor stub-up.

3.02 INSTALLATION

A. Use enclosures described in this specification only above grade.

B. Install enclosures in accordance with NEC Article 312 in locations as indicated on the Drawings.

C. Install enclosures in readily accessible locations to facilitate general operations, wire pulls, maintenance and repair.

D. Plug unused conduit openings.

E. Make conduit connections to the enclosures with watertight conduit connectors.

F. Identify all components in cabinets with phenolic nameplates as required in Section 26 05 53.

G. Use pre-printed tubular heat-shrink type wire and cable markers to label each end of all conductors.

END OF SECTION

SECTION 26 43 13
LOW VOLTAGE ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install low voltage enclosed circuit breakers fused and non-fused disconnect switches, fuses, circuit breakers and appurtenances, complete and operable, as specified herein and as shown on the Contract Drawings.

B. All equipment specified in this Section of the Specifications shall be the product of one manufacturer and shall be factory constructed and assembled by that manufacturer.

1.02 RELATED WORK

A. Refer to Section 26 05 01 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets and catalog data for each individual item shall be submitted. Switch internal arrangement.

3. Breaker or fuse characteristic curves.

4. Instructions for handling and storage

5. Dimensions and weights

B. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

C. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 26 05 74. Submittals made prior to such approval will be returned unreviewed.

D. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

E. The original equipment manufacturer shall create all equipment shop drawings, including all wiring diagrams, in the manufacturer's Engineering department. All equipment shop drawings shall bear the original equipment manufacturers logo, drawing file numbers, and shall be maintained on file in the original equipment manufacturer's archive file system. Photocopies of the Engineer's ladder schematics are unacceptable as shop drawings.

F. Submit to the Owner/Engineer, shop drawings and product data, for the following:

1. Product data sheets and catalog numbers for overcurrent protective trip devices on circuit breakers and switches, relaying, meters, pilot lights, etc. The manufacturer's name shall be clearly visible on each cut sheet submitted. List all options, trip adjustments and accessories furnished specifically for this project.

2. Provide control systems engineering to produce custom unit elementary drawings showing interwiring and interlocking between components and to remotely mounted devices. Include and identify all connecting equipment and remote devices on the schematics. The notation "Remote Device" will not be acceptable. Show wire and terminal numbers. Indicate special identifications for electrical devices per the Drawings.

3. Provide plan and elevation drawings of each controller or enclosure, with dimensions, exterior and interior views, showing component layouts, controls, terminal blocks, etc.

4. Schematic diagram

5. Nameplate schedule

6. UL Listing of the completed assembly.

7. Component list with detailed component information, including original manufacturer's part number.

8. Conduit entry/exit locations

9. Assembly ratings including:

    a. Short-circuit rating.

    b. Voltage

    c. Continuous current

10. Major component ratings including:

    a. Voltage

    b. Continuous current

    c. Interrupting ratings

11. Number and size of cables per phase, neutral if present, ground and all cable terminal sizes.

12. Key interlock scheme drawing and sequence of operations.

13. Busway connection and amperage rating.

14. Instruction and renewal parts books.

G. Factory Tests. Submittals shall be made for factory tests specified herein.

H. Field Test Reports. Submittals shall be made for field tests specified herein.

I. Operation and Maintenance Manuals.

1. Operation and maintenance manuals shall include the following information:

a. Manufacturer's contact address and telephone number for parts and service.

b. Instruction books and/or leaflets

c. Recommended renewal parts list

d. Record Documents for the information required by the Submittals paragraph above.

J. The manufacturer shall submit for approval, a training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

B. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA Standard AB1 – Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures

2. NEMA KS1: Enclosed Switches

3. NFPA 70 – National Electrical Code (NEC)

4. NFPA 70E – Standard for Electrical Safety in the Workplace

C. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 242 – Protection and Coordination of Industrial and Commercial Power Systems

2. IEEE 399 – Power Systems Analysis

D. Underwriters Laboratories (UL)

1. UL 98: Standard for safety enclosed switches and Dead Front Switches

2. UL 198C: High Interrupting Capacity Fuses, Current Limiting type

3. UL 198E: Class R Fuses

4. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures

5. UL 1066 – Low Voltage AC and DC Power Circuit Breakers Used in Enclosures.

E. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer. Equipment that is manufactured by a third party and "brand labeled" shall not be acceptable.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

E. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at time of shipment and shall be made available to the Contractor and Owner. The instructions shall include detailed assembly instructions including but not limited to wiring interconnection diagrams, rigging for lifting, skidding, jacking and moving using rolling equipment to place the equipment, bolt torquing requirements for bus and all other components which require the installation of bolted connections, and instructions for storing the equipment prior to energizing.

C. Equipment shall be stored indoors and protected from moisture, dust, and other contaminants.

D. Equipment shall not be installed until the location is finished and protected from the elements.

1.07 WARRANTY

A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Eaton
2. ABB
3. Schneider Electric Co
4. Siemens
5. Approved equal.

B. Fuses

1. Eaton
2. Ferraz Shawmut Fuses

3. Littlefuse Incorporated

4. Approved equal.

C. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

D. All equipment furnished under this Section shall be of the same manufacturer.

2.02 RATINGS

A. The service voltage shall be as shown on the Drawings. The overall short circuit withstand, and interrupting rating of the equipment and devices shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the circuit breaker or switch. Systems employing series connected ratings for main and feeder devices shall not be used.

B. Circuit breakers, safety switches and associated devices shall be designed for continuous operation at rated current in a 40°C ambient temperature.

C. Furnish heavy duty Mill rated devices.

D. For additional ratings and construction notes, refer to the Drawings.

2.03 CONSTRUCTION

A. General

1. Refer to Drawings for: actual layout and location of equipment and components; current ratings of devices, components; protective relays, voltage ratings of devices, components, and assemblies; and other required details.

2. Furnish lugs for incoming wiring, sizes as shown on the Drawings. Allow adequate clearance for bending and terminating of cable size and type specified, Lugs for #12 AWG up to #6 AWG shall be ring terminals. Conductors #4 AWG and larger shall be two-hole long barrel lugs with NEMA spacing. All lugs shall be the closed end construction to exclude moisture migration into the cable conductor. See also Section 26 05 19 Wires and Cables (1000 Volt Maximum) for additional requirements.

3. Built in control stations and indicating lights shall be furnished where shown on the Drawings.

4. Furnish nameplates for each device as indicated in Drawings. Nameplates shall be engraved, laminated impact acrylic, matte finish, not less than 1/16-inch thick by 3/4-inch by 2-1/2-inch, Rowmark 322402. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X 1/2 inch, or equal. Prior to installing the nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues has been removed. Epoxy adhesive or foam tape is not acceptable.

B. Enclosures

1. General

a. Provide 316 SS hardware for all enclosures.

b. All enclosure doors shall have bonding studs. The enclosure interior shall have a bonding stud.

c. Enclosures shall not have holes or knockouts for conduit entry.

d. All panels installed outdoors shall have a factory applied, suitable primer and final coat of weatherproof white paint.

e. All enclosures shall be provisioned with hardware for a padlock.

f. All enclosures shall have integral welded mounting lugs or mounting feet. Bolt-on lugs or mounting feet are not acceptable.

g. See Section 26 05 33 Raceways, Boxes and Fittings for additional requirements.

2. NEMA 7/4X

a. Class 1, Division 1, Groups A, B, C, and D, or as defined in NFPA 70). Boxes shall be constructed as follows:

1) Copper free cast aluminum body and cover

2) Stainless steel hinges

3) Watertight neoprene gasket

4) Stainless steel cover bolts

5) All penetrations shall be factory drilled and tapped.

3. NON-METALLIC

a. Chemical Rooms. NEMA 4X constructed as follows:

1) PVC or Fiberglass reinforced polyester body and door.
2) UV inhibitors
3) Luggage type quick release latches
4) Foam-in-place gasketed doors

4. ALUMINUM
   a. NEMA 4X Aluminum
      1) Type 5052 aluminum, body and door
      2) Stainless steel hinge
      3) Foam in-place gasket
      4) Single point quarter turn latches
5. NEMA 12
   a. NEMA 12 Steel
      1) Mild steel body and door
      2) Stainless steel hinges
      3) Foam in-place gasket
      4) Single point quarter turn latches
6. NEMA 4X Stainless Steel were not otherwise Defined
   a. Where an enclosure is not otherwise defined or shown on the Drawing
      1) NEMA 4X Stainless Steel
      2) Type 316 stainless steel, body and door
      3) Stainless steel hinge
      4) Foam in-place gasket
      5) Single point quarter turn latches
7. NEMA 1 or NEMA 1A boxes shall not be used.
8. Malleable iron boxes shall not be used.

9. Provide a flange mounted, or through the door, disconnect operating handle with mechanical interlock having a bypass that will allow the enclosure door to open only when the circuit breaker or switch is in the OFF position. The circuit breaker or switch shall have the capability of being bypassed after the door has been opened.

C. Internal Wiring

1. Wiring: Stranded tinned copper, minimum size No. 14 AWG, with 600 Volt, 90°C, flame retardant, Type MTW thermoplastic 600-volt insulation, NEMA Class II, Type B wiring. Line side power wiring shall be sized for the full rating or frame size of the connected device.

2. All wiring shall be tagged and coded with an identification number as shown on the Drawings. Coding shall be typed on a heat shrinkable tube applied to each end showing origination and destination of each wire. The marking shall be permanent, non-smearing, solvent-resistant type like Raychem TMS-SCE, or equal. Wire tags shall be machine-printed. Wire tags relying on adhesives of any type are unacceptable.

3. All wiring shall be neatly bundled with tie wraps and supported to wire way supports. Control wiring shall be bundled separately from power wiring. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

D. Field Installed Internal Wiring

1. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring. Wiring shall not be supported using adhesive supports. Adhesive wire supports are unacceptable, and if installed shall be removed and replaced with a non-adhesive support with no increase in Contract Price or Time.

2. All field wiring shall be tagged and coded with an identification number. Coding shall be typed on a heat shrinkable tube applied to each end of the wire. The marking shall be a permanent, non-smearing, solvent-resistant type like Raychem TMS-SCE, or equal. Wire tags shall be machine-printed. Wire tags relying on adhesives of any type are unacceptable.

3. In general, all conduit entering or leaving equipment shall be stubbed up into the bottom of the enclosure directly below the area in which the conductors are to be terminated, or from the top if shown on the Drawings and not located in a wet, damp or any process area. Conduits shall not enter the side unless approved in writing by the Owner/Engineer.

2.04 CIRCUIT BREAKERS

A. Insulated Case Circuit Breakers (ICCBs)

1. Unless otherwise shown on the Drawings, circuit breakers, larger than a 1200 ampere rating, shall be insulated case (ICCB), three-ole, 600 volt, fixed type, with stored energy closing mechanism.

2. Breakers shall be manually operated unless indicated as electrically operated (EO) on the Drawings.

3. Electrically operated breakers shall be complete with [close/open pushbuttons or a control switch, as shown on the Drawings, with red and green indicating lights to indicate breaker contact position, and 120-volt AC motor operators.

4. All insulated case circuit breakers shall have a minimum symmetrical interrupting capacity of 42,000 amperes, with individual interrupting capacity as shown on the Drawings. Insulated case circuit breakers without an instantaneous trip element adjustment shall be equipped with a fixed internal instantaneous override set at the upper limit.

5. All insulated case circuit breakers shall be constructed and tested in accordance with UL 489. The circuit breakers shall carry a UL label.

6. All insulated case circuit breakers shall have an adjustable long-time pickup, and delay; adjustable short time pickup and delay; short time i2t switch; high range instantaneous (fixed at the breaker's short-time withstand rating), adjustable ground fault pickup and delay; ground fault delay and pickup trips for selective tripping], and overload, short circuit , and ground fault indicator lights.

B. Molded Case Circuit Breakers (MCCB's)

1. Unless otherwise shown on the Drawings, circuit breakers 225 ampere frame rating and larger, shall be molded case (MCCB), three-Pole, 600-volt, fixed type, with stored energy closing mechanism. Breakers shall be manually operated unless indicated as electrically operated (EO) on the Drawings. Trip device shall be solid state with adjustable long time pickup, and delay; adjustable short time pickup and delay; short time i2t switch; adjustable instantaneous pickup, adjustable ground fault pickup and delay, and ground fault delay and pickup trips for selective tripping.

2. Unless otherwise shown on the Drawings, circuit breakers less than 225 ampere frame rating shall be molded case, three-Pole, 600-volt, fixed type, manually operated with stored energy closing mechanism. Circuit breakers shall have inverse time and instantaneous tripping characteristics.

3. Where shown on the Drawings or specified in the Contract Documents, breakers shall be rated for 100% continuous duty, and shall carry a UL 489 listing.

2.05 DISCONNECT SWITCHES

A. Disconnect switches shall be heavy duty, quick make, quick break, visible blades, 600-volt, three-pole with full cover interlock, interlock defeat and flange mounted operating handle.

2.06 FUSED DISCONNECT SWITCHES

A. Fused disconnect switches shall be heavy duty, quick make, quick break, visible blades, 600 volt, three-pole with full cover interlock, interlock defeat and flange mounted operating handle.

B. Fuses shall be rejection type, 600 volts, 200,000 A.I.C., dual element, time delay, Bussman Fusetron, Class RK 5 or equal.

2.07 MOTOR ISOLATION SWITCHES

A. For motors up to and including 100 horsepower, the isolating switch shall be a horsepower rated, quick make, quick break, visible blades, 600 volt, three *pole motor circuit switch, in an enclosure as listed above and sized for the motor as shown on the Drawings. The switch shall be plainly marked "Do not operate under load".*

B. *For motors greater than 100 horsepower, the isolating switch shall be a current rated, quick make, quick break, visible blades, 600-volt, three pole motor circuit switch, in an enclosure as listed above and sized for the motor as shown on the Drawings. The switch shall be plainly marked "Do not operate under load*".

C. Where a switch status auxiliary contact is shown on the Drawings, the auxiliary contact shall be early break (opens before the switch is opened) and early make (closes before the switch is closed). The auxiliary contact shall be rated 5 amperes at 480 volts.

2.08 Double Throw Manual Transfer Switch

A. Manual transfer switches shall be heavy duty, quick make, quick break, visible blades, 600-volt, three-pole, fused or non-fused as shown on the Contract Documents, with flange mounted operating handle.

2.09 SPARE PARTS

A. Provide the following spare parts:

1. Three – Fuses of each type used.

B. Spare parts shall be boxed or packaged for long term storage and clearly identified on the exterior of package. Identify each item with manufacturers name, description and part number.

2.10 FACTORY TESTING

A. The circuit breakers and disconnects shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer's routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.

B. Factory test equipment and test methods shall conform with the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards, and shall be subject to the Owner/Engineer's approval.

PART 3 EXECUTION

3.01 INSTALLER'S QUALIFICATIONS

A. Installer shall be specialized in installing low voltage circuit breakers and disconnect switches with minimum five years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.02 EXAMINATION

A. Examine installation area to assure there is enough clearance to install the equipment.

B. Verify that the equipment is ready to install.

C. Verify field measurements are as instructed by manufacturer.

3.03 INSTALLATION

A. Install all equipment per the manufacturer's recommendations and Contract Drawings.

B. Install required safety labels.

C. Conduit entry into the top of any NEMA 4/4X rated enclosure in any outdoor, damp, wet or process area is strictly prohibited. Any enclosure entered from the top will be removed and replaced, the conduit and conductors re-routed, or conductors replaced if too short. No increase in Contract Price or Contract Time will be allowed.

3.04 FIELD QUALITY CONTROL

A. Inspect installed equipment for anchoring, alignment, grounding, and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

3.05 FIELD ADJUSTING

A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

B. The Power Monitoring and Protective Devices shall be set in the field by a qualified representative of the manufacturer in accordance with settings designated in a coordinated study of the system as required in Section 26 05 74 Power System Study. All such settings, including the application of arc flash labels, shall have been made and Approved by the Owner/Engineer, prior to energizing of the equipment.

3.06 FIELD TESTING

A. Perform all electrical field tests recommended by the manufacturer. Disconnect all connections to solid-state equipment prior to testing.

B. Megger and record phase to phase and phase to ground insulation resistance. Megger, for one minute, at minimum voltage of 1000 volts DC. Measured Insulation resistance shall be at least 100 megohms. In no case shall the manufacturer's maximum test voltages be exceeded.

C. Test the ground fault protection system using a high current injection method.

D. Test the rating plug for correct rating.

3.07 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.08 EQUIPMENT PROTECTION AND RESTORATION

A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

END OF SECTION

SECTION 26 29 13
REDUCED VOLTAGE SOLID STATE STARTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reduced voltage solid state (RVSS) starters.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.
3. Section 26 05 53 – Electrical Identification.

C. Refer to Section 26 05 01 for related work and electrical coordination requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standards Institute (ANSI).
2. ETL Testing Laboratories (ETL).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C62.41.1 – Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
4. National Electrical Manufacturer's Association (NEMA):
   a. 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
5. National Fire Protection Association (NFPA):
   a. 70 – National Electrical Code (NEC).
6. Nationally Recognized Testing Laboratory (NRTL).
7. Occupational Safety and Health Administration (OSHA).
8. Underwriter's Laboratory, Inc. (UL):
   a. 508A – Standard for Industrial Control Panels.

B. Qualifications:

1. Provide RVSSs that are listed and labeled by UL, ETL, or other NRTL as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.
   a. Where listed RVSSs and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508A.
2. RVSS Supplier shall maintain an authorized service organization within 300 miles of the project site.

C. Coordination:

1. RVSS manufacturer shall verify with the RVSS is compatible with the driven equipment motor over its required operating range and will do so without exceeding the motor or RVSS safety factors.
2. RVSS shall be supplied complete with all required control components.
    a. RVSS manufacturer shall review the application and provide, at no additional cost to the Buyer, the hardware and software necessary to allow the RVSS to control the driven equipment motor over its required operating range.
        1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
    b. Coordinate control devices with devices furnished with driven equipment such as Control Panels, vibration switches, thermal sensors, leak detectors, etc.

1.3 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 23 – Submittals for requirements for the mechanics and administration of the submittal process.
2. Schedule of RVSS's for the project listing for each RVSS:
    a. Equipment Tag Number.
    b. RVSS Complete Catalog Number.
    c. RVSS Frame Size.
    d. Rated Input Current.
    e. Rated Continuous Output Current.
    f. Rated Short Circuit Current.
    g. Motor Manufacturer.
    h. Motor Frame Size.
    i. Motor Full Load Amps.
    j. Motor Service Factor.
3. Product technical data:
    a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
    b. Manufacturer’s installation instructions.
    c. Manufacturer’s programming and operating instructions.
4. Fabrication and/or layout drawings:
    a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.

b. Identify minimum clearances from other RVSSs or electrical equipment required for proper cooling at top, bottom, sides and back of enclosure.

c. Three (3) line diagrams showing AC schematic of RVSS, input, output and bypass devices including device ratings.

d. Interior layout drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.

e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.

5. Certifications:

a. Submit with Shop Drawings:

1) Letter from the RVSS manufacturer stating that the specific application has been reviewed and that the RVSS will satisfy the duties required with the actual motor furnished.

2) Identification and location of closest authorized service organization.

b. Submit prior to shipment:

1) Certified factory test reports confirming compliance with specified requirements.

c. Submit after installation:

1) Certified field service reports showing:

a) Each RVSS is operational.

b) Each RVSS and its driven equipment motor is compatible.

c) Each RVSS responds correctly to the input control signals.

B. Operations and Maintenance Manuals:

1. See Specification Section 01 33 23 – Submittals and Specification Section 01 78 23 Operation and Maintenance Data for requirements for:

a. The mechanics and administration of the submittal process.

b. The content of Operation and Maintenance Manuals.

2. Approved copy of RVSS schedule per Submittals Article.

3. Manufacturers instruction manuals.

4. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.

5. Connection data to permit removal and installation of recommended smallest field-replaceable parts.

6. Recommended spare parts list.

7. Commissioning sheets showing “as-left” values of all user-programmable or adjustable drive parameters.

1.4 WARRANTY

A. Provide warrantees, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for three years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.5 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Reduced voltage solid state starters:

a. Allen Bradley.

b. ASEA-Brown Bovari (ABB).

c. Cutler-Hammer.

d. Benshaw.

e. General Electric Company.

f. Siemens.

g. Eaton.

h. Square D Company.

B. Submit request for substitution in accordance with Division 01 – Product Substitutions.

2.2 GENERAL

A. The RVSS shall consist of a six (6) SCR power section with two (2) SCRs per phase connected inverse parallel for variable AC output voltage with minimal motor and starter heating.

B. The RVSS power section shall be capable of providing maximum torque per amp throughout the motor's speed-torque curve.

C. The logic control shall consist of a power section for gating the drive SCRs and a control section for performing all the necessary starter functions.

D. A snubber circuit shall be used to prevent false firing of SCRs due to dV/dt effects.

E. The RVSS shall be provided with a by-pass contactor that will effectively "short" the SCR power section to the incoming line to the motor load without the SCR voltage drop.

1. The contactor shall be a thermal rated contact to bypass the soft starter.

2. A horsepower rated across-the-line starter used to start the motor on a failure of the RVSS starter is not required.

F. RVSSs, whether installed in motor control center (MCC) construction or separately-mounted, shall constitute complete combination motor controllers per NEC Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.

1. Motor control.
2. Motor overload protection.
3. Motor and motor branch circuit short circuit and ground fault protection.
4. Motor and controller disconnecting means.

G. RVSSs shall be “engineered” or “configured” drive packages in which the RVSS chassis, all input, output and bypass power devices, RVSS accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory assembled and tested by the RVSS manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Application:

1. RVSSs shall be designed to operate successfully under the following site conditions:
   a. Ambient:
      1) Temperature: -10°C to 50°C (Enclosed).
      2) 95 percent non-condensing relative humidity.
   b. Elevation: 3300 FT above MSL.
   c. Power supply characteristics:
      1) 480V, 3 PH, 3-wire, (+/- 10 percent).
      2) Effectively grounded.
   d. Available short circuit current:
      1) 65,000A RMS SYM.

B. Ratings and Performance Specifications:

1. Voltage rating:
   a. Nominal: 460 or 480 Vac, 3 PH, 60 Hz.
   b. Range for continuous full load operation: 432-528 Vac.
   c. Voltage imbalance tolerance for full load operation: 3 percent minimum.
2. Current ratings:
   a. Continuous: Equal to or greater than the motor nameplate full load current multiplied by the motor service factor.
   b. Short-term overload: 500 percent for 30 seconds.
   c. Short circuit:

1) 65,000A RMS SYM, minimum.

3. Efficiency: 98 percent, minimum, at full speed and full load.

C. Operational Features:

1. Pump control functions
2. Insensitive to input phase sequence.
3. Continued operation with momentary voltage dips of 25 percent of rated voltage, or single-phase condition: 3 sec, minimum.
4. Controls power loss ride-through: 500 msec, minimum.
5. Anti-windmilling; ability to safely start into turning motor, forward or reverse.

D. The RVSS shall be provided with the following minimum user-programmable parameters:

1. Selectable torque ramp start or current limit start.
2. Starts per hour.
3. Time between starts.
4. Initial current, maximum current and ramp time.
5. Kick current and time.
6. Torque ramp.
7. Motor deceleration time.
8. Relay outputs.

E. The RVSS shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:

1. General:

a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the RVSS motor system shall be provided with automatic reset, with shutdown cause logged in memory:

1) Input under/over voltage.
2) Input under/over frequency.
3) Input phase loss.

b. Shutdown conditions which indicate overload or fault within the RVSS, the output circuit, or the motor shall require local manual reset at the RVSS, requiring operator intervention.

1) Shorted SCR.
2) Component failure.
3) Under/over current.

a) Coordinate under current set points with the Owner's representative.

4) Overload.
5) Short circuit
6) Ground fault.
7) Logic fault.

c. When automatic shutdown occurs, RVSS shall restart only when remote run signal is removed and reapplied, whether the drive is in automatic or manual mode.
d. RVSS shall hold cause of trip data for a minimum of four shutdowns in memory.
1) Data to be accessible through the keypad, local communication link and remotely.
e. Common alarm contact.

2. Input protection:
a. Input circuit breaker or current-limiting fuses with externally operable disconnect:
1) Fault current interrupting rating equal to or greater than the specified withstand rating of the RVSS.
2) Handle padlockable in the OFF position.
b. Incoming line transient suppression:
1) 6000 V peak per IEEE C62.41.1.
2) Phase-to-phase and phase-to-ground protection.

3. Internal protection:
a. Surge suppression and power device snubbers.
b. SCR peak inverse voltage (PIV): 2.5 times line voltage.
c. Instantaneous overcurrent trip.
d. Power device overtemperature trip.
e. Control logic circuit malfunction trip.

4. Output protection:
a. Inverse-time overload trip:
1) UL Class 10 characteristic.
b. Overvoltage trip.
c. Over frequency trip.
d. Short circuit trip:
1) Line to line and line to ground.
e. Ground fault trip.

2.4 OPERATOR AND REMOTE-CONTROL INTERFACE

A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.

1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.

B. Control circuits shall be 115 Vac or 24 Vdc:

1. 115 Vac supplied by CPT in the RVSS enclosure.

a. CPT shall have a minimum additional capacity of 100 VA greater than that required by control devices.

b. CPT shall have two (2) fuses on the primary side and one fuse on the secondary side.

2. 24 Vdc supplied by Class 2 power supply in the RVSS enclosure.

a. Power supply shall have minimum additional capacity of 33 percent greater than that required by control devices.

b. Provide two (2) current-limiting fuses on the AC supply to the power supply.

C. Operator Interface:

1. Door mounted sealed keypad, membrane type with LED or LCD display.

a. Messages shall be in English and engineering units.

b. Drive operating parameters shall be programmable.

c. Menu driven.

d. Password security.

e. Display fault and diagnostic data.

f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.

1) Fault descriptions shall be in plain text.

2) Fault codes are not acceptable.

g. Gold plated plug-in contacts.

2. HAND-OFF-REMOTE selector switch.

3. Status indication:

a. POWER ON.

b. RUN STATUS.

c. RVSS FAULT.

4. Metering indications (minimum):

a. Amperes.

b. Voltage.

c. Frequency.

5. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.

a. On occurrence of more than one condition each shall be recorded or indicated by the diagnostics.

D. Remote Control Interface:

1. Contacts:

a. Contacts shall be rated 7 A inductive at 120 Vac.

b. All contacts shall be wired to field wiring terminal boards.

2. Network communications capability:

a. Provide RVSS with communication card, protocol and required programming for digital communication of all RVSS program and operational parameters to plant control system via:

1) Ethernet IP.

2.5 EQUIPMENT CONSTRUCTION

A. Fabrication and Assembly:

1. Each RVSS system shall be factory-assembled in an enclosure for remote mounting and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.

a. Factory assembly shall be performed by the RVSS manufacturer or authorized agent.

b. Systems fabricated or assembled in whole or in part by parties other than the RVSS manufacturer will only be acceptable if done by a UL508A panel shop.

2. Cooling fans shall be provided, as required, to run when the temperature setpoint is reached.

3. Enclosures for separately mounted RVSSs:

a. NEMA Type 1 for installation in Electrical Rooms.

b. NEMA Type 12 for installation in other unclassified areas.

B. Wiring:

1. The wiring in the RVSS shall be neatly installed in wire ways or with wire ties and looms where wire ways are not practical.

a. Where wire ties are used, the wire bundles are to be held at the back panel with an adhesive-backed mounting base.

2. All plug-in contacts shall be gold-plated.

3. Provide terminal boards for all field wiring and inter-unit connections.

4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.

a. They shall be non-brittle, interlocking, track-mounted type similar to Phoenix Contact UT 4-MTD.

b. Screw terminals will not be allowed.

c. A terminal shall be provided for each conductor of external circuits plus one ground for each shielded cable.

d. For free-standing panels, 8 IN of clearance shall be provided between terminals and the panel base for conduit and wiring space.

e. Not less than 25 percent spare terminals shall be provided.

f. Terminals shall be labeled to agree with identification indicated on the supplier's submittal drawings.

g. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.

5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal.

a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.

6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coded.

a. Markings or color code shall match the manufacturer's drawings.

7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, type MTW or SIS, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.

C. Auxiliary Control Devices:

1. Selector switches, pushbuttons, indicating lights and control relays as specified.

D. Nameplates:

1. RVSS enclosure shall be provided with a suitable nameplate as specified in Specification Section 26 05 53 – Electrical Identification.

2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.

3. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.

4. Use stainless steel screws to attach nameplates.

E. Factory Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at least one coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

2.6 SOURCE QUALITY CONTROL

A. Factory Tests:

1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.
2. Prior to final assembly:
    a. Inspect incoming components.
    b. Test and inspect power devices.
    c. Circuit cards:
        1) Component and functional tests:
        2) Burn-in chamber or temperature cycling test.
        3) System test after burn-in, or temperature cycling.
3. After final assembly:
    a. Continuity and insulation test of 480 Vac circuits.
        1) Test voltage shall be 2500 Vdc.
    b. Continuity and insulation test of 120 Vac circuits.
        1) Test voltage shall be 500 Vdc.
    c. Drive tests:
        1) Burn-in complete drive at full load for 24 HRS.
        2) Verify all auxiliary circuits operation.
        3) Monitor output variables.
    d. Systems test:
        1) Provide inputs to field connections and simulate on-site operation.
        2) Test all auxiliary equipment.

2.7 MAINTENANCE MATERIALS

A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).

B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.

B. Verify the installed motor nameplate electrical requirements do not exceed the RVSS capacity.

3.2 START-UP

A. Pre-Start-up Services:

1. Shall be completed a minimum of 30 days prior to the start-up and demonstration period.
    a. Shall consist of physical and electrical installation check.
2. Final adjustments and calibration of drive parameters.
3. Shall be complete when RVSSs are fully operational.

B. Start-up and Demonstration Services:

1. Provide services of manufacturer's representative to perform start-up services.
    a. Minimum of 1 trip with 8 HRS at the jobsite.
2. Supervise start-up of all units including recheck of settings made during the pre-start-up tests.
    a. Perform all work in the presence of the Owner's Representatives.
3. Simulate operation of the RVSS and its associated control and instrumentation system in both the manual and automatic modes.
    a. Ensure compatibility of RVSS with associated control and instrumentation signals.
4. Simulate RVSS failures and demonstrate troubleshooting aids.

3.3 OWNER TRAINING

A. Instruct Owner's Designated Personnel:

1. Minimum of 4 HRS at the jobsite.
2. See Division 01.
3. Include both field and classroom instruction.
4. Instructions shall include proper operation and maintenance procedures including, but not limited to:
    a. Lubrication.
    b. Troubleshooting.
    c. Repair and replacement.
    d. Parts inventory.
    e. Maintenance records.

END OF SECTION

SECTION 26 29 23
LOW VOLTAGE VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install separately enclosed low voltage adjustable frequency drives, together with appurtenances, complete and operable, as specified herein and as shown on the Contract Drawings. The terms, VFD, ASD, AFD and Inverter are used synonymously.

B. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 26 29 23. Submittals made prior to such approval will be returned unreviewed.

C. All equipment supplied under this Section of the Specifications shall be products of the same Manufacturer and shall be contained in one single submittal. Partial submittals will be returned unreviewed. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned unreviewed.

D. Equipment specified in the Process Equipment Division and supplied as an integral part of a process equipment manufacturer's package, but referred to this Section for component details, shall be submitted with the manufacturer's package submittal under the Process Equipment Sections.

E. The minimum requirements for functionality, and control and alarm inputs and outputs, are specified herein. Additional requirements shall be as specified in the Process Equipment Division, Instrumentation Division Equipment, Mechanical Division Equipment, and the Contract Drawings.

F. Coordinate the VFD and the motor it drives and provide a certification that the VFD is suitable for the application.

1.02 RELATED WORK

A. Refer to Section 26 05 01 for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

B. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 26 05 74. Submittals made prior to such approval will be returned unreviewed.

C. Submittals shall also contain information on related equipment to be furnished under this. Incomplete submittals not containing the required information on the related equipment will be returned unreviewed.

D. All equipment shop drawings, including all wiring diagrams, shall be created in the original equipment manufacturer's Engineering department. All equipment shop drawings shall bear the original equipment manufacturers logo, drawing file numbers, and shall be maintained on file in the original equipment manufacturer's archive file system. Photocopies of the Engineer's ladder schematics are unacceptable as shop drawings.

E. Submit for approval, a manufacturer's conducted training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual.

F. Submit to the Owner/Engineer, shop drawings and product data, for the following:

1. Product data sheets and catalog numbers for all components of the drives, including motor contactors, drive components, control relays, control stations, meters, pilot lights, etc. The manufacturer's name shall be clearly visible on the each cut sheet submitted. List all options, trip adjustments and accessories furnished specifically for this project. Clearly mark each sheet to indicate which items apply and/or those items that do not apply.

2. Provide drive performance specifications. Submit a manufacturer's harmonics test on each type of drive being furnished. The test may be on a similar unit with identical components.

3. Provide control systems engineering to produce custom unit elementary drawings showing interwiring and interlocking between components and to remotely mounted devices. Include and identify all connecting equipment and remote devices on the schematics. The notation "Remote Device" shall not be acceptable. Show wire and terminal numbers. Indicate special identifications for electrical devices per the Drawings.

4. Provide plan and front and side views of equipment elevation drawings of each controller or enclosure, with dimensions, exterior and interior views, showing component layouts, controls, terminal blocks, etc.

5. Schematic diagram, including manufacturer's selections of component ratings, and CT and PT ratios.

6. Nameplate schedule

7. UL Listing of the completed assembly

8. Component list with detailed component information, including original manufacturer's part number.

9. Conduit entry/exit locations

10. Assembly ratings including:

    a. Short-circuit rating

    b. Voltage

    c. Continuous current

    d. Trip curves for each specified product

11. Major component ratings including:

    a. Voltage

    b. Continuous current

    c. Interrupting ratings

12. Number and size of cables per phase, neutral if present, ground and all cable terminal sizes.

13. Instruction and renewal parts books.

G. Certification that the VFD being supplied is suitable for the application.

H. Factory Tests. Drives supplier to provide typical factory test description. Drives are to be 100% tested at the factory prior to shipment. All drives are to be powered with a motor load. Submittals shall be made for additional factory tests specified herein.

I. Field Test Reports. Drives commissioned in the field by the manufacturer's representative shall be included in the start-up report. The report will include installation overview, application description, drive wiring description, and parameter settings as programmed for the application. Comments on drive performance as commissioned shall be also noted in the field report. Submittals shall be made for additional field tests specified herein.

J. Operation and Maintenance Manuals.

1. Operation and maintenance manuals shall include the following information:

    a. Manufacturer's contact address and telephone number for parts and service.

    b. Instruction books and/or leaflets

    c. List of diagnostic indicators.

    d. Recommended renewal parts list

    e. Record Documents for the information required by the Submittals paragraph above.

    f. Submit operation and maintenance data notebook in accordance with Section 01 78 23 - Operations and Maintenance Data.

    g. Information and drawings submitted must reflect the final installed condition. Revise documents requiring updates following testing and start-up.

    h. In addition to the content specified in Section 01 78 23 - Operation and Maintenance Data, provide the following information:

    i. Name, address, and telephone number of the VFD supplier's local service representative.

    j. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.

    k. Copy of approved submittal information and system shop drawings as specified in Paragraph 1.3, Submittals, with corrections made to reflect actual system as tested, delivered and installed at the site. Provide half-size blackline reproductions of all shop drawings larger than 11 inches x 17 inches.

    l. Start-up software.

    m. Parameter list and drive software configuration file.

    n. Manufacturer's hardware, software, installation, assembly and operations manuals for the VFD. Provide all manuals in PDF format DVD-RW.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NEMA Standard ICS 2 – 2000 Industrial Control and Systems

2. National Electrical Manufacture's Association (NEMA). ISC 7.0 Industrial Controls & Systems for AFD

3. NFPA 70 – National Electrical Code (NEC)

4. NFPA 70E – Standard for Electrical Safety in the Workplace

5. Institute of Electrical and Electronic Engineering (IEEE). Standard 51-2014, IEEE Guide for Harmonic Content and Control.

6. IEEE 519 (latest revision) - Guide for Harmonic Control and Reactive Compensation of static Power Converters

7. UL 489 – Standard for Safety for Molded-Case Circuit Breakers

8. UL 508C – Power Conversion Equipment

9. NEMA ICS 2 – Starters, Contactors, Overload Relays, Rated Not More Than 200 Volts AC or 750 Volts DC.

10. NEMA ICS 6 – Industrial Control and Systems Enclosures

11. NEMA ICS 7.0 – Industrial Controls & Systems for VFD

12. IEC 61200-2 – Vibration Levels

13. IEC 61800-02 and -3 – Adjustable Speed Electrical Power Drive Systems

    a. Fulfill all EMC immunity requirements

14. EN 50082-1 and -2 – Test Standards

B. In the case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

C. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer. Equipment that is manufactured by a third party and "brand labeled" will not be acceptable.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.

E. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

F. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at time of shipment and shall be made available to the Contractor and Owner/Engineer.

C. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

D. Equipment shall be installed in its permanent finished location shown on the Drawings within seven calendar days of arriving onsite. If the equipment cannot be installed within seven calendar days, the equipment shall not be delivered to the site, but stored offsite until such time that the site is ready for permanent installation of the equipment with no change in the Contract Price or Schedule. Payment will not be approved for equipment stored off site.

E. Where space heaters are provided in equipment, provide temporary electrical power, and operate space heaters during storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.07 WARRANTY

A. Provide warrantees, including the manufacturer’s warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Eaton
2. ABB
3. Schneider Electric Co.
4. Rockwell Automation
5. Danfoss
6. WEG
7. Siemens
8. Approved equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. All equipment furnished under this Section shall be of the same manufacturer.

2.02 RATINGS

A. Service Conditions

1. The Drawings indicate the approximate horsepower and intended control scheme of the motor driven equipment. Provide the VFD, auxiliary components and equipment where shown or specified, and matched to the motors and control equipment supplied, in compliance with the NEC. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the Owner.

2. The service voltage shall be as shown on the Drawings. The overall short circuit withstand and interrupting rating of the VFD and devices shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the adjustable frequency drives. Adjustable frequency drives shall be tested, and UL labeled for the specified short circuit duty in combination with the motor branch circuit protective device.

3. The drive shall be UL and cUL listed and not require external fuses. The drive shall also be CE labeled and comply with standards EN 61800-3 for EMC compliance and EN 61800-2 for low voltage compliance.

4. The drive shall be capable of operating in compliance with IEEE 519-1992.

5. Input power: Selectable for 200-240 or 380-480 VAC, 3-phase power input.

6. Input frequency: 57 to 63 Hz.

7. Ambient temperature: -10°C to 50°C (Enclosed).

8. Elevation: Up to 3300 feet above mean sea level.

9. Relative humidity: Up to 90% non-condensing.

B. The VFD, for both constant and variable torque applications, shall be sized for a motor one NEMA size larger than the motor being supplied.

C. The VFD output shall be 100% rated current continuous, suitable for operation of the driven equipment over a 30:1 speed range without overloading or low speed cogging. Drives shall be capable of a continuous overload up to 110% rated current and a maximum 150% overload for 1 minute. Starting torque shall be matched to the load.

D. Rated output voltage shall be programmable for motor ratings from 180 to 240 volts, or from 320 to 480 volts.

E. The Drive shall be able to operate after a voltage dip below 175 VAC on 230 VAC input power and 310 VAC on 460 VAC input power for 15 milliseconds at 85% full load current without any disturbances in output power delivered to the load.

F. The VFD output voltage shall vary with frequency to maintain a constant volts/hertz ratio up to base speed (60 hertz) output. Constant or linear voltage output shall be supplied at frequencies greater than base speed (60 hertz).

G. The VFD overload current rating shall be 110% of rated current for one minute for variable torque applications and 150% of rated current for constant torque applications, in an ambient temperature of 104ºF.

H. The VFD shall have an efficiency at full load and speed that exceeds 95% for VFDs below 15 HP and 97% for drives 15 HP and above. The efficiency shall exceed 90% at 50% speed and load.

I. The true power factor shall be 0.95 or better at any speed, measured at drive input terminals.

J. The voltage regulation shall be plus or minus 1% of rated value, no load to full load.

K. Output Frequency Drift shall be not more than plus or minus 0.5% from setpoint.

L. VFDs shall withstand five cycle transient voltage dips of up to 15% of rated voltage without an undervoltage trip or fault shutdown, while operating a variable torque load.

M. Line notching, transients, and harmonics on the incoming line shall not affect drive performance.

N. The VFDs shall meet IEC 61200-2 for vibration levels.

O. The VFDs shall be able to withstand voltage variations of -15% to +10% and imbalance up to 3% without tripping or affecting drive performance.

P. For additional requirements and construction notes, refer to the Drawings.

2.03 CONSTRUCTION

A. General

1. Refer to Drawings for: actual layout and location of equipment and components; current ratings of devices, components; protective relays, voltage ratings of devices, components, and assemblies; and other required details.

2. Control units shall be arranged as shown on the Drawings.

3. Surge Protective Devices

a. Furnish where shown on the Drawings, or specified herein, a manufacturer provided and installed, a Low Voltage Surge Protective Device (SPD), as specified in Section 16196 of these Specifications.

b. Connection to the switchgear shall be with a surge rated disconnect, mounted integral to the switchgear.

c. Except for VFD components, where the equipment contains a programmable logic controller (PLC) or an uninterruptible power supply (UPS), the equipment manufacturer shall furnish factory installed, a dedicated Point of Utilization Device (SPD), with disconnecting means, as specified in Section 16196, Individual Control Panel and Related Equipment Protection (Type 3).

4. Where Kirk-Key arrangements are used, the Kirk keyed interlocks shall be Kirk HD Series (Heavy Duty) 316 Series of 316 stainless steel or approved equal.

5. Nameplates

a. External

1) Nameplates shall be engraved, laminated impact acrylic, matte finish, not less than 1/16-in thick by 3/4-in by 2-1/2-in, Rowmark 322402. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X 1/2", or equal. Prior to installing the nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues has been removed. Epoxy adhesive or foam tape is not acceptable.

2) Provide a master nameplate that indicates equipment ratings, manufacturer's name, shop order number and general information. Cubicle nameplates shall be mounted on the front face, on the rear panel and inside the assembly, visible when the rear panel is removed.

3) Provide permanent warning signs as follows:

a) "Danger- High Voltage- Keep Out" on all doors.

b) "Warning- Hazard of Electric Shock - Disconnect Power Before Opening or Working On This Unit" on main power disconnect.

b. Internal

1) Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification, corresponding to appropriate designations on manufacturer's wiring diagrams.

c. Special

1) Identification nameplates shall be white with black letters, caution nameplates shall be yellow with black letters, and warning nameplates shall be red with white letters.

6. Control Devices and Indicators

a. All operating control devices, indicators, and instruments shall be securely mounted on the panel door. All controls and indicators shall be 30mm, corrosion resistant, NEMA 4X/13, anodized aluminum, or reinforced plastic. Booted control devices are not acceptable. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical and electrical equipment requirements.

b. Indicator lamps shall be LED type. For all control applications, indicator lamps shall incorporate a push-to-test feature. Lens colors shall be as follows:

1) Red for ON, Valve OPEN, and Breaker CLOSED.

2) Green for OFF, Valve CLOSED and Breaker OPEN.

3) Amber for FAIL.

4) Blue for READY

5) White for POWER ON.

c. Mode selector switches (HAND-OFF-AUTO, LOCAL-OFF-REMOTE, etc.) shall be as shown on the Drawings. Units shall have the number of positions and contact arrangements, as required. Each switch shall have an extra dry contact for remote monitoring.

d. Pushbuttons, shall be as follows:

1) Red for STOP, Valve OPEN, Breaker OPEN and mushroom Red for EMERGENCY STOP.

2) Green for START, Valve CLOSE and Breaker CLOSE.

3) Black for RESET.

e. Furnish nameplates for each device. All nameplates shall be laminated plastic, black lettering on a white background, attached with stainless steel screws. Device mounted nameplates are not acceptable.

f. The manufacturer shall not remove, reuse, alter, or replace original equipment nameplates or equipment tags associated with equipment or components supplied by the manufacturer's suppliers and sub-suppliers.

g. Control and Instrument Power Transformers

1) Control power transformers shall be provided where shown on the Drawings. Transformer shall be sized for the entire load, including space heaters, plus 25% spare capacity. Provide a load calculation showing that the sizing of the control power transformer complies with this requirement.

2) Control power transformers shall be 120 volts grounded secondary. Primary side of the transformer shall be fused in both legs. One leg of the transformer secondary shall be solidly grounded while the other leg shall be fused.

h. Current Transformers

1) Current transformers shall be furnished as indicated on the contract drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. The location for the current transformers shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections.

2) Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

3) Current transformers used on power quality meters shall be instrument accuracy.

4) Relays and meters shall not be placed on the same CT.

5) Differential relays shall be placed on dedicated CTs.

7. A failure alarm with horn and beacon light shall be provided when required or specified. Silence and Reset buttons shall be furnished. Alarm horn and beacon shall be by Federal Signal; Crouse-Hinds, or equal, NEMA 4X for all areas except for NEMA 7 areas, which shall be NEMA 7 cast aluminum.

8. Where specified or shown on the Drawings, a six-digit, non-resettable elapsed time meter shall be installed on the face of each motor starter. Meter shall be as specified in Section 16197.

9. Each VFD shall have an HMCP or thermal magnetic circuit breaker, as shown on the Drawings, to provide a disconnect means. VFDs above 75HP shall have a solid-state circuit breaker. Disconnecting means shall have a through the door lockable handle, mechanically interlocked with the enclosure door. The disconnect shall not be mounted on the door. The handle position shall indicate ON, OFF, and TRIPPED condition. The handle shall have provisions for padlocking in the OFF position with at least three (3) padlocks. Interlocks shall prevent unauthorized opening or closing of the VFD door with the disconnect handle in the ON position. Door handle interlock shall be defeatable only by qualified maintenance personnel.

10. Each VFD shall have the application specific, Hand-Off-Remote and Auto-Manual selector switches for local and remote Auto-Manual operation, provisions to accept a remote dry contact closure to start and stop the drive with the drive control system in the AUTO mode, provisions to accept a 4-20 mA dc input signal for remote speed control, and other input, output and communications interfaces as shown on the Drawings. Inputs shall be isolated at the drive and active with the drive control system in the AUTO mode.

11. Each VFD shall be microprocessor based with an LED and LCD display to monitor operating conditions. The Drive display section shall allow for local operation and setting of Drive function codes and display fault indication and reasons associated with the fault. The LED display shall offer nine different display settings and the LCD shall have the capacity to display five lines of information at a time. The keypad shall be capable of copying, uploading, and downloading drive function codes. Displays and settings shall be as specified for each of the horsepower ranges of VFDs.

12. Where shown on the Drawings, furnish a motor over-current relay, or other protective or monitoring relays, as specified herein, to provide information to the Owner's Multilin PMCS based HMI system.

13. Where shown on the Drawings, the VFD shall have an AC output contactor to provide a means for positive disconnection of the drive output from the motor terminals.

14. Where shown on the Drawings, furnish a three-contactor assembly, including a drive input disconnect, an VFD input isolation contactor, bypass contactor and an VFD output contactor that is electrically and mechanically interlocked with the bypass contactor. This circuit shall include control logic, status lights and motor over-current relays. The complete bypass system shall have controls, pilot lights, etc., as shown on the Drawings.

B. Enclosures

1. General

a. Each enclosure shall incorporate a removable back panel, and side panels, on which control components shall be mounted. Back panel shall be secured to the enclosure with collar studs for wall mounted enclosures, and 316 SS hardware for free standing enclosures.

b. All free-standing enclosures shall be provided with feet of the same construction as the enclosure.

c. The enclosure door shall be interlocked with the main circuit breaker by a panel mounted cable driven operating mechanism.

d. Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any components.

e. All enclosure doors shall have bonding studs. The enclosure interior shall have a bonding stud.

f. Each enclosure shall be provided with a documentation pocket on the inner door.

g. Enclosures shall not have holes or knockouts.

h. Provide manufacturer's window kits where shown on the Drawings.

i. All panels installed outdoors shall have a factory applied, suitable primer and final coat of weatherproof white paint.

j. All enclosures shall be pad lockable.

k. Enclosures manufactured by the vendor shall meet the requirements of this specification and the requirements of Section 26 05 33, Raceways, Boxes, Enclosures, and Fittings.

2. NEMA 7/4X

    a. Class 1, Division 1, Groups A, B, C, and D, or as defined in NFPA 70). Boxes shall be constructed as follows:

        1) Copper free cast aluminum body and cover

        2) Stainless steel hinges

        3) Watertight neoprene gasket

        4) Stainless steel cover bolts

        5) All penetrations shall be factory drilled and tapped.

    b. Manufacturers

        1) Eaton

        2) Appleton Electric

        3) Approved equal.

3. NON-METALLIC

    a. Chemical Rooms. NEMA 4X constructed as follows:

        1) PVC or Fiberglass reinforced polyester body and door.

        2) UV inhibitors

        3) Luggage type quick release latches

        4) Foam-in-place gasketed doors

    b. Manufacturers

        1) Hoffman Polypro

        2) Hubbell-Wiegmann Non-Metallic

        3) Approved equal.

4. ALUMINUM

    a. NEMA 4X Aluminum

        1) Type 5052 aluminum, body and door

        2) Stainless steel continuous hinge

3) Foam in-place gasket

4) Single point quarter turn latches (20”x24” and below). All others 3-point latch

b. Manufacturers

1) Hoffman

2) EMF Company

3) NEMA Enclosures Company

4) Hammond Company

5) Approved equal.

5. NEMA 12

a. NEMA 12 Aluminum

1) Type 5052 aluminum, body and door

2) Stainless steel continuous hinge

3) Foam in-place gasket

4) Single point quarter turn latches (20”x24” and below). All others 3-point latch

b. Manufacturers

1) Hoffman

2) EMF Company

3) NEMA Enclosures Company

4) Hammond Company

5) Approved equal.

6. Not Defined

a. Where an enclosure is not otherwise defined or shown on the Drawing

1) NEMA 4X 316 Stainless Steel

2) Type 316 stainless steel, body and door

3) Stainless steel continuous hinge

4) Foam in-place gasket

5) Single point quarter turn latches (20”x24” and below). All others 3-point latch

b. Manufacturers

1) Hoffman

2) EMF Company

3) NEMA Enclosures Company

4) Hammond Company

5) Approved equal.

7. NEMA 1 or NEMA 1A boxes shall not be used.

8. Malleable iron boxes shall not be used.

C. Cooling Fans

1. Fans shall be furnished for VFDs, as required by the manufacturer, to provide air circulation and cooling. The fan shall be controlled by a thermostat and shall operate only when the drive is “ON” and for a cool-down period after the drive has stopped. Otherwise, the fan shall not run when the drive is “OFF”. Louvers, if provided, shall have externally removable filters. The filter shall be metallic and washable.

2. Fan motors shall be protected by an input circuit breaker. Metal squirrel cage ball bearing, three phase fan motors with 10-year design life shall be used in the drive design. Plastic muffin fans are not acceptable. Fan power shall be obtained from a tap on the main control power transformer.

3. A “loss of cooling” fault shall be furnished. In the event of clogged filters or fan failure, the drive shall produce an alarm and then, in a predetermined time, shut down safely without electronic component failure.

4. Redundant fans shall be provided in the drive design as backup in the event of fan failure.

D. Internal Wiring

1. Wiring: Tinned stranded copper, minimum size No. 14 AWG, with 600 Volt, 90-degree C, flame retardant, Type MTW thermoplastic insulation, NEMA Class II, Type B wiring. Line side power wiring shall be sized for the full rating or frame size of the connected device.

2. Identification: Numbered sleeve type wire markers at each termination point, color coding per NEMA standards and the NEC. Foreign voltage control wiring shall be yellow.

3. All wiring shall be tagged and coded with an identification number as shown on the Drawings. Coding shall be typed on a heat shrinkable tube applied to each end showing origination and destination of each wire. The marking shall be permanent, non-smearing, solvent-resistant type like Raychem TMS-SCE, or equal.

4. All wiring shall be neatly bundled with ty-raps and supported to wire way supports. Control wiring shall be bundled separately from power wiring. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

E. Field Installed Internal Wiring

1. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

2. All field wiring shall be tagged and coded with an identification number. Coding shall be typed on a heat shrinkable tube applied to each end of the wire. The marking shall be a permanent, non-smearing, solvent-resistant type like Raychem TMS-SCE, or equal

3. In general, all conduit entering or leaving equipment shall be stubbed up into the bottom of the enclosure directly below the area in which the conductors are to be terminated, or from the top if shown on the Drawings. Conduits shall not enter the side unless approved in writing by the Owner/Engineer.

F. Control Relays

1. Control relays shall be 300-volt, industrial rated, plug-in socket type, housed in a transparent polycarbonate dust cover, designed in accordance with UL Standard 508 for motor controller duty. Continuous contact rating shall be 10 amperes resistive, 1/4 HP at 120 VAC, operating temperature -10 to +55°C. Provide spare N.O. & N.C. contacts. Relays shall be equipped with neon coil indicator light. Timing relays shall be 300 Volt, solid state type, with rotary switch to select the timing range. All relays provided in the equipment shall be NEMA rated. IEC rated relays are not acceptable.

2.04 ADJUSTABLE FREQUENCY DRIVES (VFDS) FOR MOTORS 60 HP AND SMALLER

A. General

1. Each VFD shall be a 6-pulse, Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation, designed for use with standard induction motors, constant or variable torque as required for the load application, with current limiting input fuses, incoming line reactors, circuit breaker disconnect, [output contactor], control transformer overload relays and process signal follower card. Drives shall be UL listed. Adjustable frequency drives manufactured for HVAC applications are not acceptable. Adjustable Current Source VFDs are not acceptable. The output devices shall be Insulated Gate Bipolar Transistors (IGBTs). Bipolar Junction Transistors, GTOs or SCR' are not acceptable.

2. The VFD shall have an EMI/RFI filter as standard.

3. Each VFD shall consist of the following general components:

    a. Full wave diode rectifier to convert supply AC to a fixed DC voltage.

    b. DC link capacitors

    c. Insulated Gate Bipolar Transistor (IGBT) power section. The power section shall use vector dispersal pulse width modulated (PWM) control and soft switching IGBTs.

    d. Microprocessor based control and display section.

4. Each VFD shall, as a minimum, contain a 5% input line reactor, as standard.

5. Each VFD shall, as a minimum, contain a matrix filter as standard.

6. Input harmonic filter for drives rated 30 to 60HP. Passive or active filter rated to limit current harmonic distortion to less than 5 percent. Integrated inside the enclosure cabinet with the drive. Include isolation contactor to disconnect the filter from the line when the drive is stopped.

7. The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.

8. The Drive shall maintain set frequency regardless of load fluctuations.

9. The Drive shall be able to operate after a voltage dip below 175 VAC on 230 VAC input power and 310 VAC on 460 VAC input power for 15 milliseconds at 85% full load current without any disturbances in output power delivered to the load. If power exceeds this level, six (6) different modes or active and inactive restart modes shall be available. The decrease in motor speed shall be adjustable in the event of a momentary power outage.

10. The Drive shall have a programmable start frequency, adjustable from 0.1 to 60 hertz, with a 1 hertz resolution and with a holding time adjustable from 0.1 to 10 seconds.

11. The Drive shall have IGBT soft switching and a low noise control power supply system to reduce the noise from the drive.

12. The Drive shall have a frequency bias (starting frequency) function programmable from -120 to +120 Hz of maximum frequency, with 0.1 Hz resolution.

13. Drive frequency gain shall be programmable from 0-200%, with 0.1% resolution.

14. The Drive shall be capable of motor slowdown or stop by selectable regenerative (to the DC link) dynamic braking while following one of the four selectable deceleration ramps and control the braking torque by setting its value from 0, 20 to 150%, 999 (no limit) of Drive rating. It shall also change the rate of deceleration automatically by stopping the braking action long enough to avoid Drive over-voltage trip.

15. The Drive shall start into a rotating load (forward or reverse) and shall smoothly accelerate or decelerate to the set point without experiencing component damage.

16. The Drive shall stop by selectable DC injection braking. It shall be adjustable from 0 to 100% braking level and have a programmable starting frequency for DC braking (0.2-60 hertz) and programmable braking time (0.1 to 30.0 seconds).

17. The Drive shall have a start Frequency Setting that incorporates a Holding Time at the Frequency Setting, adjustable up to 10 seconds in duration.

18. The Drive shall provide at least three selectable skip frequencies with programmable band widths, adjustable 0 to 30 Hz, which shall not allow operation at or near mechanical resonance speeds.

19. The Drive shall provide selectable slip compensation, which shall sense output current and adjust output.

20. The Drive shall have Droop operation, balancing drooping characteristics to speed and load variations. This function shall be adjustable from –9.9 to 0.0 Hz.

21. The Drive shall have a selectable Torque Limiting function for both motoring and braking that shall sense an overload condition and shall reduce frequency and current temporarily until the load reaches acceptable levels. If the overload condition is not settled in the proper amount of time, the Drive shall trip on overload. The Torque Limiting shall be programmable from 20-150% of Drive rated motor torque (30 HP and below) and from 20-150% of Drive rated motor torque (40 HP and above), with 1% resolution.

22. The Drive shall have a selectable electronic inverse time thermal overload function as required by NEC and UL Standard 991 for an AC Induction Motor (Refer to applicable codes for specific installation requirements). The overload shall be programmable from 20 - 135% of Drive rated current.

23. The Drive shall have an over-voltage protection function that operates if supply voltage rises above rated value or by motor's regeneration.

24. The Drive shall treat short circuits in either the output load or the output module as an over-current.

25. If the Drive heat sink temperature exceeds approximately 100° C, the Drive shall shut down on over temperature fault.

26. The Drive shall provide output ground fault protection.

B. Control and Monitor Interface

1. The Control shall have a graphic back-lit liquid crystal display (LCD) which can be configured to display frequency, current, function code set points, or drive status and fault codes. It shall display lines with characters of text, providing display at a minimum of:

    a. Monitor

    b. Operate

    c. Parameter setup

    d. Actual parameter values

    e. Active faults

    f. Fault history

    g. LCD adjustments

2. Setups and Adjustments

    a. Start command from keypad, remote or communications port

    b. Speed command from keypad, remote or communications port

    c. Motor direction selection

    d. Maximum and minimum speed limits

    e. Acceleration and deceleration times, two settable ranges

    f. Critical (skip) frequency avoidance

    g. Torque limit

    h. Multiple attempts restart function.

i. Multiple preset speeds adjustment

j. Catch a spinning motor start or normal start selection

k. Programmable analog output

l. DC brake current magnitude and time

m. PID process controller

3. System Interfaces

a. Remote manual/auto

b. Remote start/stop

c. Remote forward/reverse

d. Remote preset speeds

e. Remote external trip

f. Remote fault reset.

g. Process control speed reference interface, 4-20mA DC

h. Potentiometer and 1-10VDC speed reference interface

i. Two RS-485 programming and operation interface ports

C. Outputs – A minimum of two discrete programmable digital outputs, one programmable open collector output, and one programmable analog output shall be provided, with the following available at minimum:

1. Programmable relay outputs with one set of Form C contacts for each, selectable with the following available at minimum:

a. Fault

b. Run

c. Ready

d. Reversed

e. Jogging

f. At speed

g. Torque Limit Supervision

h. Motor rotation direction opposite of commanded

i. Over-temperature

2. Programmable open collector output with available 24VDC power supply and selectable with the following available at minimum:

a. Fault

b. Run

c. Ready

d. Reversed

e. Jogging

f. At speed

g. Torque Limit Supervision

h. Motor rotation direction opposite of commanded

i. Over-temperature

3. Programmable analog output signal, selectable with the following available at minimum:

a. Motor current

b. Output frequency

c. Frequency reference

d. Motor speed

e. Motor torque

f. Motor power

g. Motor voltage

h. DC-bus voltage

i. AI1 (Analog Input 1)

j. AI2 (Analog Input 2)

2.05 ADJUSTABLE FREQUENCY DRIVES (VFDS) FOR MOTORS LARGER THAN 60 HP

A. General

1. Each drive shall be a minimum 18-pulse, IGBT based sinusoidal PWM type AC Drive or active front end (AFE) topology AC Drive capable of operating a squirrel cage induction motor with a full load current equal to or less than the continuous output of the Drive. The drive panel shall incorporate a phase shift transformer and a minimum 18 pulse converter or AFE. Regulator technology shall be software configurable to either V/Hz (single or multi motor) mode or Sensorless Dynamic Torque Vector mode (single motor). Full, closed loop flux vector control shall be available for constant torque applications. In V/Hz mode at base speed (60 hertz) and below, the Drive shall operate in constant volts per hertz mode. Above base speed (60 hertz), the Drive may selectively operate in either a constant volt per hertz mode or a constant voltage extended frequency mode.

2. The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.

3. The Drive shall maintain set frequency regardless of load fluctuations.

4. The Drive shall be able to operate after a voltage dip below 175 VAC on 230 VAC input power and 310 VAC on 460 VAC input power for 15 milliseconds at 85% full load current without any disturbances in output power delivered to the load. If power exceeds this level, six different modes or active and inactive restart modes shall be available. The decrease in motor speed shall be adjustable in the event of a momentary power outage.

5. The Drive shall have a programmable start frequency, adjustable from 0.1 to 60 hertz, with a 1 hertz resolution and with a holding time adjustable from 0.1 to 10 seconds.

6. The Drive shall have IGBT soft switching and a low noise control power supply system to reduce the noise from the drive.

7. The Drive shall have a frequency bias (starting frequency) function programmable from -120 to +120 Hz of maximum frequency, with 0.1 Hz resolution.

8. Drive frequency gain shall be programmable from 0-200%, with 0.1% resolution.

9. The Drive shall be capable of motor slowdown or stop by selectable regenerative (to the DC link) dynamic braking while following one of the four selectable deceleration ramps and control the braking torque by setting its value from 0, 20 to 150%, 999 (no limit) of Drive rating. It shall also be capable of changing the rate of deceleration automatically by stopping the braking action long enough to avoid Drive over-voltage trip.

10. The Drive shall start into a rotating load (forward or reverse) and shall smoothly accelerate or decelerate to the set point without experiencing component damage.

11. The Drive shall stop by selectable DC injection braking. It shall be adjustable from 0 to 100% braking level and have a programmable starting frequency for DC braking (0.2-60 hertz) and programmable braking time (0.1 to 30.0 seconds).

12. The Drive shall have a start Frequency Setting that incorporates a Holding Time at the Frequency Setting, adjustable up to 10 seconds in duration.

13. The Drive shall provide at least three selectable skip frequencies with programmable band widths, adjustable 0 to 30 Hz, which shall not allow operation at or near mechanical resonance speeds.

14. The Drive shall provide selectable slip compensation, which shall sense output current and adjust output.

15. The Drive shall have Droop operation, balancing drooping characteristics to speed and load variations. This function shall be adjustable from –9.9 to 0.0 Hz.

16. The Drive shall have a selectable Torque Limiting function for both motoring and braking that shall sense an overload condition and shall reduce frequency and current temporarily until the load reaches acceptable levels. If the overload condition is not settled in the proper amount of time, the Drive shall trip on overload. The Torque Limiting shall be programmable from 20-150% of Drive rated motor torque (30 HP an below) and from 20-150% of Drive rated motor torque (40 HP and above), with 1% resolution.

17. The Drive shall have a selectable electronic inverse time thermal overload function as required by NEC and UL Standard 991 for an AC Induction Motor (Refer to applicable codes for specific installation requirements). The overload shall be programmable from 20 - 135% of Drive rated current.

18. The Drive shall have an over-voltage protection function that operates if supply voltage rises above rated value or by motor's regeneration.

19. The Drive shall treat short circuits in either the output load or the output module as an over-current.

20. If the Drive heat sink temperature exceeds approximately 100ºC, the Drive shall shut down on over temperature fault.

21. The Drive shall provide output ground fault protection.

B. Control and Monitor Interface

1. The Control shall have a graphic back-lit liquid crystal display (LCD) which can be configured to display frequency, current, function code set points, or drive status and fault codes. It shall display lines with characters of text, providing display at a minimum of:

    a. Monitor

b. Operate

c. Parameter setup

d. Actual parameter values

e. Active faults

f. Fault history

g. LCD adjustments

2. Setups and Adjustments

a. Start command from keypad, remote or communications port

b. Speed command from keypad, remote or communications port

c. Motor direction selection

d. Maximum and minimum speed limits

e. Acceleration and deceleration times, two settable ranges

f. Critical (skip) frequency avoidance

g. Torque limit

h. Multiple attempt restart function

i. Multiple preset speeds adjustment

j. Catch a spinning motor start or normal start selection

k. Programmable analog output

l. DC brake current magnitude and time

m. PID process controller

3. System Interfaces

a. Remote manual/auto

b. Remote start/stop

c. Remote forward/reverse

d. Remote preset speeds

e. Remote external trip

f. Remote fault reset.

g. Process control speed reference interface, 4-20mA DC

h. Potentiometer and 1-10VDC speed reference interface

i. Programming interface port.

C. Outputs – A minimum of two discrete programmable digital outputs, one programmable open collector output, and one programmable analog output shall be provided, with the following available at minimum:

1. Programmable relay outputs with one set of Form C contacts for each, selectable with the following available at minimum:

a. Fault

b. Run

c. Ready

d. Reversed

e. Jogging

f. At speed

g. Torque Limit Supervision

h. Motor rotation direction opposite of commanded

i. Over-temperature

2. Programmable open collector output with available 24VDC power supply and selectable with the following available at minimum:

a. Fault

b. Run

c. Ready

d. Reversed

e. Jogging

f. At speed

g. Torque Limit Supervision

h. Motor rotation direction opposite of commanded

i. Over-temperature

3. Programmable analog output signal, selectable with the following available at minimum:

a. Motor current

b. Output frequency

c. Frequency reference

d. Motor speed

e. Motor torque

f. Motor power

g. Motor voltage

h. DC-bus voltage

i. AI1 (Analog Input 1)

j. AI2 (Analog Input 2)

2.06 METERING AND PROTECTIVE RELAYS

A. Furnish where shown on the Drawings, a Motor Protection System (MP3), as shown on the Drawings, and as specified in Section 16197 Power Metering and Protective Relays.

B. Furnish where shown on the Drawings, a Power Quality Meter (PM1), for each Main or Feeder Breaker, as shown on the Drawings and as specified in Section 16197 Power Metering and Protective Relays.

C. Provide separate metering accuracy CTs for Power Quality Meters.

D. All CT secondary conductors shall be terminated on shorting type terminal blocks before proceeding to any other device.

E. Do not connect Power Quality Meters and protective relays on the same CT circuit.

2.07 REMOTE MONITORING AND CONTROL INTERFACE

A. General: All control and interconnection points from the equipment to the plant control and monitoring system shall be brought to a separate connection box. No field connections shall be made directly to the equipment control devices. Functions to be brought out shall be as specified in the Instrumentation Divisions.

B. Discrete control or status functions shall be form C relays with contacts rated at 120 volts AC. Analog signals shall be isolated from each other.

C. Equipment functions to be directly interfaced to the Plant Control and Monitoring System, shall be designed for operation with an Ethernet Connection.

D. The equipment manufacturer shall factory enter the proper IP Address for such connection. Upon request by the Contractor, the Owner/Engineer will provide the proper Internet Protocol Address (IP Address), to be configured by the equipment manufacturer.

E. Refer to the Instrumentation Divisions for monitored parameters.

F. Communication

1. For remote monitoring, one of the following communication capabilities shall be provided:

    a. One integral 10/100BaseT Ethernet port supporting Modbus TCP, Ethernet IP and SNMP protocols.

    b. One media protocol converter, interfacing the provided equipment to a 10/100BaseT Ethernet port supporting Modbus TCP, Ethernet IP and SNMP.

2. The protocol interface shall implement the following:

    a. All data shall be available and/or mirrored within the Modbus 4x or "Holding Register" memory area.

    b. Register 4x00001 shall exist and be readable to allow simple, predictable "comm tests".

3. The media protocol converter shall meet the following criteria:

    a. The converter shall support 10/100Base-T Ethernet. The serial port speed (baud rate) shall support 230kbps. The protocol shall support Modbus TCP, Ethernet IP, DF1, and Modbus RTU/ASCII. Protocol shall be Web Browser configurable.

    b. Operating limits shall be 0-60 degrees C, with humidity range minimum of 5-90 percent. Shock capability on the serial port shall be ESD +15 kV air GAP meeting IEC 1000-4-2. Power requirements shall be 9-30VDC at 0.5A minimum.

    c. The converter shall have LED status for serial, signals, power, and Ethernet.

d. The converter housing shall be UL 1604, Class 1 Div 2, DIN Rail mountable. The converter shall have DB-9M port connection, with screw terminals, to the input.

e. Converter shall be Digi One IAP or approved equal.

2.08 SPARE PARTS

A. Provide the following spare parts:

1. Three – Control fuses of type used.

2. Three – Power fuses of type used.

B. Spare parts shall be boxed or packaged for long term storage and clearly identified on the exterior of package. Identify each item with manufacturers name, description and part number.

2.09 FACTORY TESTING

A. The VFDs shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer's routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.

B. Prior to factory testing, submit confirmation that the manufacturer has checked and verifies that all selections and settings required by the Power System Study Engineer have been performed.

C. Factory test equipment and test methods shall conform with the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards.

D. The operational test shall include the proper connection of supply and control voltage and, as far as practical, a mockup of simulated control signals and control devices shall be fed into the boards to check for proper operation.

PART 3 EXECUTION

3.01 MANUFACTURER'S REPRESENTATIVE

A. Provide the services of a qualified factory-trained manufacturer's field engineer to assist in the installation and start-up of each type of the equipment specified below for a period of not less than two working days, with not less than one working day per VFD. The manufacturer's field engineer shall provide technical direction and assistance in general assembly of the equipment, connections, and adjustments, and testing of the assembly and components contained therein.

3.02 INSTALLER'S QUALIFICATIONS

A. Provide an installer who shall be specialized in installing low voltage adjustable frequency drives with minimum five years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.03 EXAMINATION

A. Examine installation area to assure there is enough clearance to install the equipment.

B. Housekeeping pads shall be included for the floor mounted motor controllers as detailed on the Drawings except for motor controllers which are to be installed adjacent to an existing unit. Housekeeping pads for these (if used) should match the existing installation.

C. Check concrete pads and baseplates for uniformity and level surface.

D. Verify that the equipment is ready to install.

E. Verify field measurements are as instructed by manufacturer.

3.04 INSTALLATION

A. Install all equipment per the manufacturer's recommendations and Contract Drawings.

B. Install required safety labels.

3.05 FIELD QUALITY CONTROL

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

3.06 FIELD ADJUSTING

A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

B. The Power Monitoring and Protective Relays shall be set in the field by a qualified representative of the manufacturer, in accordance with settings designated in a coordinated study of the system as required in Section 26 05 74 Power System Study. All such settings, including the application of arc flash labels, shall have been Approved by the Owner/Engineer, printed and attached to the equipment prior to energizing of the equipment.

3.07 FIELD TESTING

A. The VFD manufacturer’s field engineer shall perform all electrical field tests recommended by the manufacturer and make all control adjustments required for the individual application of the drive.

B. Submit the results of all specified tests to the Engineer/Owner within five business days for approval and for their permanent records.

3.08 CLEANING

A. Remove all rubbish and debris from inside and around the motor controllers. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.09 EQUIPMENT PROTECTION AND RESTORATION

A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.10 MANUFACTURER'S CERTIFICATION

A. Provide the services of a qualified factory-trained manufacturer's representative who shall certify in writing that the equipment has been installed, adjusted, including all settings designated in the Power System Study, and tested in accordance with the manufacturer's recommendations.

B. Provide three copies of the manufacturer's representative's certification.

3.11 TRAINING

A. Provide manufacturer's services for training of plant personnel in operation and maintenance of the adjustable frequency drives furnished under this Section.

B. The training for each type of equipment shall be for a period of not less than one eight-hour day.

C. The cost of the training program to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied.

D. Provide detailed O&M manuals to supplement the training course. The manuals shall include specific details of equipment supplied and operations specific to the project.

E. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, motor starters, protective devices, metering, and other major components.

F. The Owner reserves the right to videotape the training sessions for the Owner's use.

END OF SECTION

SECTION 26 35 33
AUTOMATIC POWER FACTOR CORRECTION EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide labor, equipment, supervision and materials for the installation, handling, testing and start-up of the automatic power factor correction equipment:

B. The automatic power factor correction equipment shall be designed to maintain 0.95 power factor at the service connection under all conditions of plant operation.

C. The current transformer (CTs) provided shall be sized such that the automatic power factor correction equipment will function properly under all plant operating load conditions. The CTs shall be multi-ratio type.

1.02 RELATED WORK

A. Electrical work is included in Division 26.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01 33 23, shop drawings and product data as follows:

1. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, weight, shipping splits, conduit entrances and anchor bolt pattern. Indicate all options, special features, ratings and deviations from the specifications.

2. Power and control schematics including external connections. Show wire and terminal numbers and color coding.

3. Multi ratio CT's, including the recommended tap to be utilized such that the equipment will function properly under all plant operating load conditions.

4. Performance specifications.

5. Instruction and replacement parts books.

6. Certified shop test reports.

7. As-built final drawings.

8. Field test and inspection reports.

1.04 REFERENCE STANDARDS

A. IEEE Standard 519 (latest revision) - "Guide for Harmonic Control and Reactive Compensation of Static Power Converters."

B. Power capacitors shall comply with UL 810, ANSI/IEEE Standard 18-1980 and NEMA CP1-1973.

C. Capacitor assembly shall comply with UL 508A.

D. National Electrical Code (NFPA 70) latest edition.

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Equipment components and devices shall be UL labeled to the extent possible wherever UL standards exist for such equipment.

B. Only pre-qualified manufacturers will be considered for this project. Pre-qualified manufacturers are listed in Paragraph 2.02.

1.06 DELIVERY, STORAGE AND HANDLING

A. Package the equipment for maximum protection during delivery and storage.

B. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture, chemicals, hydrogen sulfide and chlorine gas.

1.07 OPERATING INSTRUCTIONS

A. After approval, during and after construction, operating manuals covering instruction and maintenance on each type of equipment shall be furnished in accordance with Section 01 78 23.

B. The instructions shall be bound and shall provide at least the following as a minimum:

1. A comprehensive index.

2. A complete "as-built" set of approved shop drawings.

3. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

4. Full specifications on each item.

5. Updated system schematic drawings "as built", illustrating all components and electrical connections of the systems supplied under this Section.

6. Detailed service, maintenance and operation instructions for each item supplied.

7. A table listing of the "as left" set up parameters, timing relay settings and alarm and trip set points.

8. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

9. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.

10. Complete parts list with stock numbers, including spare parts.

1.08 WARRANTY

A. Individual capacitor cells shall be covered by a two year warranty.

B. The automatic power factor correction equipment shall be warranted by the automatic power factor correction equipment manufacturer.

1.09 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 RATING

A. Service Conditions

1. Input power: 480 VAC, plus 10 percent, minus 10 percent, 3 Phase, 60 Hz.

2. Input frequency: 57 to 63 Hz.

3. Ambient temperature: 0 to 40 degrees C.

4. Elevation: Up to 3300 feet above mean sea level.

5. Relative humidity: Up to 90 percent non-condensing.

B. The insulation rating of the capacitor cells shall be 600 Volts. The kVAR ratings specified are based on a 480 V application.

C. The total capacity of each unit shall be as shown on the Electrical One Line Drawings.

D. The total KVAR of each unit shall be divided into 60 percent KVAR non-switched (fixed) and 40 percent KVAR automatically switched in steps of 25 percent KVAR.

E. Terminal bushings shall withstand 3 KV AC to ground and be rated 15 KV BIL or greater.

F. Nominal design life of individual capacitor cells shall be 20 years.

2.02 CONSTRUCTION

A. General

1. The general arrangement and location of the power factor correction equipment is shown on the Electrical One Line Drawings. All equipment shall be furnished by one of the manufacturers:
   a. Myron Zucker
   b. Trans-Coil, Inc. (TCI)
   c. ASEA Brown Boveri
   d. Cutler-Hammer
   e. Power Survey
   f. Square D Co.

2. The equipment shall operate satisfactorily when connected to a bus supplying solid state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds.

B. Capacitor Cells

1. Individual capacitors shall be self-healing utilizing polypropylene as a dielectric with vacuum deposited conductors on the polypropylene as electrodes.

2. Each three phase capacitor shall be furnished with a UL listed pressure sensitive interrupter. The interrupter shall disconnect two or three phases at the same time to maintain a balanced circuit.

3. Capacitors shall be contained in hermetically sealed metal cans to prevent atmospheric contaminants from shortening the useful life.

4. Dielectric material shall be low loss, less than 0.5 watts per KVAR and shall include the discharge resistor losses in accordance with UL 810.

5. Dielectric fluid shall be non-PCB biodegradable with a flash point in excess of 415 degrees F.

6. All capacitor cells shall have threaded studs for wire connection.

7. To reduce line transients on system no stage shall switch more than 100 KVAR and no capacitor cell shall exceed 50 KVAR.

8. All three phase capacitors shall be UL listed.

9. Power wiring shall have a thermoplastic insulation rated for 105 degrees C at 600 volts.

10. System wiring connections shall be made to copper bus bars. System shall be designed and braced for a short circuit level of 65,000 amps RMS symmetrical short circuit current.

11. Contactors shall be rated for switching of reactive current by the contactor manufacturer.

12. Air core transient suppression coils shall be provided in series between the contactors and capacitor cells or contactors shall be equipped with pre-insertion resistors to reduce switching transients.

13. All wiring connections shall be mechanically fixed with nut or screw.

C. Discharge Resistors

1. Capacitor "cells" shall be provided with discharge resistors to reduce residual voltage to less than 50 volts within one minute of de-energization. (National Electrical Code Article 460-6).

2. Resistors shall be chosen to insure a 20 year minimum life.

D. Fuses

1. To provide for major fault protection, line fuses shall be provided on all three phases of each switched stage and fixed banks.

2. Line fuses shall be current limiting. Minimum interrupting ratings shall be 100,000 amps for fuses up to 30 amps and 200,000 amps for fuses 30 amps and above.

3. Fuses shall be designed for capacitor applications and shall be rated not less than 180 percent capacitor current rating.

4. Line fuses shall be installed with clip style fuse holders.

E. Enclosure

1. Components shall be mounted in free standing, front accessible, NEMA 12, force ventilated with filtered air, single or multi-bay, sheet steel cabinets with hinged front doors. Doors shall have concealed hinges and three-point latching mechanism with lockable handle. Rear access shall not be required.

2. Incoming line power cables shall enter at the top of the cabinet.

3. Each cabinet shall have a molded case, circuit breaker type main power disconnect switch, with an external operating handle. The circuit breaker shall have a short circuit rating of specified in Paragraph 2.02B.10 and shall be labeled in accordance with UL Standard 489.

4. Provide the following safety features:

a. Provision to padlock main disconnect handle in the OFF position.
b. Mechanical interlock to prevent opening cabinet door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.
c. Mechanical or electrical interlocks on doors of auxiliary sections of multi-bay cabinets interlocked with the main circuit breaker power disconnect.
d. Auxiliary contact on main disconnect to isolate control power when fed from an external source.
e. Barriers and warning signs on terminals that are energized with the power disconnect OFF.

5. Provide an equipment ground bus or lug connectors in each structure, suitable for connection to the copper grounding conductors shown on the Drawings.

F. Control Wiring

1. Wiring: 600 volt, stranded copper, 105 degree C color coded insulation, minimum size No. 14 AWG (120 VAC control power only).

2. Identification and termination: Crimp type wire lugs with sleeve type markers at each termination point. Provide numbered terminal blocks for external connections.

3. Control power: Provide a 120 VAC, fused, control power transformer for cooling fans and external control circuits. Control circuits shall be isolated from power circuits. Control power transformers shall be two-winding dry type with primary fuses, secondary circuit breaker and NEMA sized for the application

G. Controls

1. All controls shall be mounted on enclosure door for easy inspection and service.

H. VAR Controller

1. Controller shall measure the reactive current on every passage of the voltage through zero.

2. LEDs shall be provided to indicate the stages that are on. The second set of LEDs shall indicate whether capacitors are being added or shed from the circuit.

3. To prevent leading power factor the controller shall be provided with an integral target cosine selector switch.

4. The time delay between switching of capacitors must be field programmable and have a range of 25 seconds to 5 minutes to reduce hunting and allow voltage decay as required by NEC.

5. All output contacts shall be disabled within 10 milliseconds of main power interruption. After restoration of supply voltage the outputs shall be energized in sequence.

I. On/Off Switch

1. On/off switch shall control power to all door mounted controls.

2. On/Off switch shall contain pilot light to indicate on mode.

J. Blown Fuse Lights

1. Blown fuse lights shall be included for each fuse in each step and shall be visible with the door closed..

K. Auxiliary Contacts

1. Provide two sets of Form C auxiliary dry contacts for remote indication of each fault condition.

L. Marking and Identification

1. Provide 2-in by 5-in, nominal, engraved lamicoid master nameplates on each enclosure fastened with stainless steel screws or rivets. Nameplates shall be black with white core, 3/8-in high lettering and shall indicate equipment designation as shown on the Drawings.

2. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of pilot devices and meters.

3. Provide permanent warning signs as follows.
   a. "Danger-High Voltage-Keep Out" on all cabinet doors.
   b. "Warning-Hazard of Electric Shock - Disconnect power before opening or working on this unit" on main power disconnect.

M. Current Transformers

1. Current transformers shall be toroidal type suitable for mounting on breaker stabs. Continuous thermal current rating, relaying and metering accuracy shall conform to ANSI standards.

2.03 SURFACE PREPARATION AND SHOP COATINGS

A. All non-current carrying metal parts of the equipment cabinet shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.

B. Indoor equipment shall be finish painted with one coat of manufacturers standard electro-coated, heat cured enamel.

C. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion. Printed circuit boards shall be coated with a protective conformal epoxy. All device contacts shall be gold or silver plated.

2.04 SHOP TESTING

A. Perform manufacturers standard production testing and inspection in accordance with UL, NEMA and ANSI standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. The equipment shall be leveled and anchored directly to the concrete equipment pad or finished floor. Provide hardware and metal shims for installation. Grout and caulk all voids beneath the equipment base. Anchor bolts shall be 1/2-in galvanized steel.

B. Install the equipment in accordance with the manufacturer's instructions.

C. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.

D. Make wiring interconnections between shipping splits. Care shall be taken to preserve the location of the CT connection to the controller.

3.02 FIELD TESTING

A. Make the following minimum test and checks before the manufacturer's representative is called in for testing and adjustment.

1. Verify that all connections are completed in accordance with shop drawings.

2. Verify supply voltage and phase sequences are correct.

3. Check mechanical interlocks for proper operation.

4. Test ground connections for continuity and resistance.

5. Adjust unit compartment doors.

6. Check control circuit interlocking and continuity.

B. The manufacturer's service technician shall perform start-up and adjustment of the power factor correction equipment. After adjustment and start-up, the power factor correction equipment shall be tested under inductive load.

C. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Engineer and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Engineer

3.03 ADJUSTMENT

A. Make all internal adjustments and all adjustments necessary for manual and automatic operation of the entire system.

3.04 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

B. Replace all cabinet ventilation filters upon commencement of the Contract warranty period.

END OF SECTION

SECTION 26 36 00
TRANSFER SWITCHES

PART 1 - GENERAL

1.1 GENERAL

A. Section Includes:

1. Manual transfer switches.
2. Automatic transfer switches.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.
3. Section 26 05 01 – Electrical General Provisions.

1.2 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. National Electrical Manufacturers Association (NEMA):
   a. 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
2. Underwriters Laboratories, Inc. (UL):
   a. 98 – Standard for Safety Enclosed and Dead-Front Switches.
   b. 1008 – Standard for Safety Switch Equipment.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 – Submittals for requirements for the mechanics and administration of the submittal process.
2. Product technical data:
   a. Provide submittal data for all products specified in PART 2 of this Specification Section.
   b. See Specification Section 26 05 01 – Electrical General Provisions for additional requirements.

B. Operation and Maintenance Manuals:

1. See Specification Section 01 33 00 – Submittals and Specification Section 01 78 23.13 – Operation and Maintenance Data for requirements for:

a. The mechanics and administration of the submittal process.

b. The content of Operation and Maintenance Manuals.

2. Commissioning sheets showing "as-left" values of all user-programmable or adjustable drive parameters

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 26 05 01 – Electrical General Provisions.

1.6 WARRANTY

A. Provide warrantees, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for three years except for variable frequency drives which shall be for three years, from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the listed manufacturers are acceptable:

1. Automatic transfer switches:

a. Automatic Switch Company.

b. Kohler.

c. Onan.

d. Russelectric.

e. Zenith Products.

2. Manual transfer switches:

a. Automatic Switch Company.

b. Eaton.

c. General Electric Company.

d. Russelectric.

e. Square D Company.

f. Siemens.

g. Zenith Products.

B. Submit request for substitution in accordance with Specification Section 01 25 13 – Product Substitutions.

2.2 MANUAL TRANSFER SWITCH

A. Double throw load break rated with:

1. Quick-make/quick-break operating mechanism.
2. Deionizating arc chutes.
3. Double-break rotary action shaft and switchblade shall be manufactured as one (1) common component.
4. Clear line shields to prevent accidental contact with line terminals.

B. Operating handle: Easily recognizable and padlockable in both positions.

C. Wiring configuration to allow single load to be supplied by a normal or alternate source.

D. Ratings:

1. Voltage and amperage: As indicated on Drawings.
2. Short circuit withstand: Equal to or greater than the upstream equipment.

E. Enclosure:

1. NEMA 1A rated:
   a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   b. With or without knockouts, hinged and lockable door.

F. Standards: NEMA KS 1, UL 98.

2.3 AUTOMATIC TRANSFER SWITCH

A. Construction:

1. Electrically operated mechanically held, double throw, air-break type.
2. Silver-surface main contacts and protect by arcing contacts.
3. Switch shall have provisions for visual inspection of switch blades and contacts.
4. Mechanical design will positively open all ungrounded conductors from normal source before connection is made to alternate source and will positively open alternate source before connection is made to normal source.
5. Mechanical interlock to ensure the switch cannot be readily disabled, disconnected, improperly adjusted, removed or otherwise made inoperative.
6. Make all contacts and coils readily accessible for replacement from front of panel without major disassembly.
7. Ratings:
   a. Continuous duty in both normal and emergency.
   b. four-pole, four-wire.
   c. Voltage and current ratings as indicated on the Drawings.
   d. Short circuit withstand rating equal to or greater than the normal source electrical gear.
8. Standards: UL 1008.

B. Operation:

1. Microprocessor based control module.
2. Open Delayed open transition.
3. Red and green indicating lights with fuses, identification nameplates, and test switch on front to simulate normal power failure at switch.
4. Engine starting contacts and all other auxiliary contacts and accessory devices for functions to be performed.
5. Supervisory voltage relays on each phase of normal source and single phase supervisory voltage and frequency relay for emergency source.
    a. Normal source voltage sensing.
        1) Adjustable pickup from 85-100 percent of rated voltage, factory set 90 percent.
        2) Adjustable dropout from 75-98 percent of pickup setting, factory set 85 percent.
    b. Emergency source voltage and frequency sensing:
        1) Adjustable pickup from 85-100 percent of rated voltage, factory set 90 percent.
        2) Fixed voltage dropout at 85 percent of pickup setting.
        3) Adjustable pickup from 90-100 percent of rated frequency, factory set 95 percent.
        4) Fixed frequency dropout at 88 percent of pickup setting.
6. Time delays:
    a. Engine start, adjustable from 0 to 10 seconds, factory set at 4 seconds, to avoid unnecessary starting caused by short time outages.
    b. Transfer to generator, adjustable from 0 to 120 seconds, factory set at 10 seconds.
    c. Retransfer to normal, adjustable from 2 to 30 minutes, factory set at 15 minutes to avoid erratic operation caused by short time reestablishment of normal source.
        1) Automatically bypassed when emergency source fails and normal source is available.
    d. Generator cool down, adjustable from 0 to 60 minutes, factory set at 10 minutes.
7. Exerciser timer:
    a. Enable and disable function.
    b. Selectable to exercise with or without transferring load.
    c. Adjustable exercise duration from 1 minute to 24 HRS, factory set at 15 minutes.
    d. Adjustable day of the week exercise setting, factory set for Monday.
8. Inphase monitor:

a. Compare the phase relationship and frequency difference between the normal and emergency sources and permit transfer the first time the sources are within 15 electrical degrees and only if transfer can be accomplished within 60 electrical degrees as determined by monitoring the frequency differences.

b. Inphase transfer accomplished if both sources are within 2 Hz of rated frequency and 70 percent or more of rated voltage.

C. Enclosure:

1. NEMA 1A rated.

a. Body and cover: Sheet steel finished with a rust inhibiting primer and manufacturer's standard paint inside and out.

b. No knockouts, hinged and lockable door.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Connect as indicated in one-line diagram.

C. Mounting of manual transfer switches: Wall-mounted.

D. Mounting of automatic transfer switches:

1. Wall-mounted or floor mounted on 4 IN high concrete pad.

E. Manual Transfer Switch Enclosure:

1. Permitted uses of NEMA 1A rated enclosure:

a. Surface mounted in areas designated as dry.

2. Permitted uses of NEMA 4X rated enclosure:

a. Surface mounted in areas designated as wet and/or corrosive.

3.2 FIELD QUALITY CONTROL

A. Comply with Specification Section 26 05 01 – Electrical General Provisions.

B. Comply with manufacturer's written instructions.

C. Employ and pay for services of equipment manufacturer's field representative(s) to:

1. Inspect equipment covered by this Specification Section.

2. Supervise adjustments and installation checks.

3. Conduct initial startup of equipment and perform operations checks.

4. Provide a certified startup report.

5. Provide Owner with written documentation per Specification Section 26 05 01 – Electrical General Provisions that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

6. Instruct Owner's personnel per Specification Section 01 75 00 – Facility Start Up at jobsite with minimum services as follows.
    a. Installation Assistance: 16 HRS.
    b. Owner personnel instruction, classroom and jobsite: 8 HRS.
    c. Plant startup: 16 HRS.

D. Automatic Transfer Switch Testing:
1. Simulate power outage by opening normal source overcurrent device.
    a. Verify engine generator starts and switch transfers in the specified time.
2. Close normal source overcurrent device to simulate the return of normal power.
    a. Verify the switch retransfers and engine generator shuts down in the specified time.
3. Perform a manual transfer and retransfer.
4. Verify the indicator lights function properly.

END OF SECTION

SECTION 26 41 13
LIGHTNING PROTECTION FOR STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. A lightning protection system, including design, installation and materials is required for the buildings and structures.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

1.03 RELATED SECTION

A. Division 01 – General Requirement

B. Section 40 61 21 - Process Control System Testing

C. Section 26 05 01 – Electrical General Provisions

D. Section 26 05 26 - Grounding and Bonding for Electrical Systems

1.04 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

1. NFPA No: 780 – Standard for the Installation of Lightning Protection Systems

2. NFPA No: 70 - National Electrical Code
   a. Section 250-106 – Lightning Protection Systems

B. American National Standards Institute/Underwriters Laboratories (ANSI/UL)

1. UL 96 - Lightning Protection Components

2. UL 96A - Safety Installation Requirements for Lightning Protection System

3. Lightning Protection Institute (LPI) - LPI 175 - Installation Standards

1.05 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following.

1. Lightning protection system layout including scaled plan drawings and details

2. Outline dimensions and weights
3. Installation and maintenance manual
4. Catalog data
5. Complete design and construction drawings in the latest version of AutoCAD
6. Underwriters Laboratories, Inc. Master Label Certification
7. Lightning protection institute certified system certification.
8. Operation and maintenance Data
9. Vendor Training Plan.
10. Functional and Performance Test Plan.
11. Field Test Report
12. Warranty.

1.06 QUALITY ASSURANCE

A. Designer: Lightning protection system design shall be prepared by an LPI-certified designer or recognized lightning protection manufacturer.

B. System components shall be the product of a manufacturer regularly engaged in the manufacturing of lightning protection components in accordance with UL 96.

C. Lightning protection system shall be installed under direct supervision of an LPI 175 Certified Master Installer.

D. Inspection of final installation and grounding connection shall be performed by an LPI-certified inspector.

E. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

F. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

1.07 PREPARATION FOR SHIPPING

A. Pack and crate materials to permit ease of handling and provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Advanced Lightning Technology

B. East Coast Lightning Equipment

C. Harger Lightning Protection

D. Thompson Lightning Protection

2.02 GENERAL

A. System Design: Provide a functional and unobtrusive lightning protection system. Departures from the Drawings or submittals shall be submitted to the Design-Builder for approval.

B. Repair and improvement to the existing connected structures as required to achieve the required UL Certification.

C. System Material: Aluminum**,** unless otherwise specified.

D. Material shall comply in weight, size, and composition for the class of structure to be protected as established by NFPA 780.

2.03 COMPONENTS

A. Air Terminal:

1. Material: Solid aluminum with tapered or blunt points as required for application.

2. Diameter: As required.

3. Length: Sufficient to extend minimum 10 inches above object being protected.

4. UL 96 Label B applied to each terminal.

B. Conductors:

1. Lightning System Conductors: Bare medium hard-drawn stranded copper, or stranded aluminum as required for the application.

2. Main Down Conductor: Smooth twist stranding.

3. Connecting Conductor: Concentric stranding.
4. Bonding Conductor: Flexible strap.
5. Main down and connecting conductors shall bear the UL 96 Label A, applied every 10 feet.
6. Grounding Conductors: Stranded bare copper.

C. Cable Fastener and Accessories: Capable of withstanding minimum pull of 100 pounds.

D. Fittings:

1. Heavy-duty.
2. Bolts, Screws, and Related Hardware: Stainless steel.

E. Ground Rods:

1. Material: Copper-clad steel.
2. Diameter: 5/8 inch.
3. Length: 20 feet.

F. Grounding Connections:

1. Welds: Exothermic process.
2. Fasteners: Bolted clamp type, corrosion-resistant copper alloy.
3. Through-Roof Connectors: Straight or right angle with bronze and lead seal flashing washer.

G. Cable Connections and Splicers:

1. Welds: Exothermic process.
2. Fasteners: Bolted clamp type, corrosion-resistant copper alloy.
3. Through-Roof Connectors: Straight or right angle with bronze and lead seal flashing washer.

H. Conduit: Schedule 40 PVC, as specified in Section 26 05 33 - Raceway and Boxes.

PART 3 EXECUTION

3.01 PREPARATION

A. The subcontractor is responsible for all coordination between the project subcontractors, including, but not limited to, the following:

1. The lightning protection installer shall install a correct, neat and unobtrusive installation in cooperation with other trades.

2. The roofing subcontractor shall seal and flash protection roof lightning penetrations conforming to the roof manufacturer's recommendations. However, the lightning protection subcontractor shall designate locations of through roofs and submit details of through roof penetrations, as required.

3. Should the roofing manufacturer require any special walk pads, membrane patches or pavers under the components of the lightning protection system, the lightning protection installer shall install such items with the roofing materials (patches, pads, pavers, adhesive) supplied by the roofing manufacturer at no additional cost to the lightning protection installer.

4. The roofing subcontractor shall instruct the lightning protection installer of the proper installation procedures of the roof pads, pitch-pockets, patches, and pavers, if required.

3.02 INSTALLATION

A. Air Terminals:

1. Supports: Brackets or braces.

2. Parapet Bracket Attachment: Lag or expansion bolts.

3. Secure base to roof surface with adhesive or pitch compatible with roofing bond.
   a. For standing seam roof attach to standing seam with clip.

4. Provide terminal flashing at roof penetrations.

5. Perimeter Terminals:
   a. Maximum Spacing: 20 feet.
   b. Maximum Distance from Outside Edge of Building: 2 feet.

6. Roof Ridge Terminals: Maximum spacing 20 feet.

7. Mid-Roof Terminals: Maximum spacing 50 feet.

8. Provide blunt point air terminals for applications exposed to personnel.

B. Conductors:

1. Conceal whenever practical.

2. Provide 1-inch PVC conduit in building walls or columns for main downleads and roof risers.

3. Attach to roof standing seam with clips.

4. Support: Maximum spacing for exposed conductors.
   a. Vertical: 3 foot.
   b. Horizontal: 4 foot.

5. Maintain horizontal and vertical conductor courses free from dips or pockets.

6. Bends: Maximum 90 degrees, with minimum 8-inch radius.

7. Install air terminal conductors on the structural roof surface before roofing composition is applied.

C. Bonding:

1. Bond to Main Conductor System:
   a. Roof mounted ventilators, fans, air handlers, masts, flues, cooling towers, handrails, and other sizeable metal objects.
   b. Roof flashing, gravel stops, insulation vents, ridge vents, roof drains, soil pipe vents, and other small metal objects if located within 6 feet of main conductors or another grounded object.

2. Bond each steel column or major framing members to grounding system.

3. Bond each main down conductor to grounding system.

D. Grounding System:

1. Grounding Conductor:
   a. Completely encircle building structure.
   b. Bury minimum 1 foot below finished grade.
   c. Minimum 2 feet from foundation walls.

2. Interconnect ground rods by direct-buried copper cables.

3. Maximum Resistance: 1 ohm when connected to ground rods.

4. Connections:
   a. Install ground cables continuous between connections.
   b. Exothermic welded connections to ground rods, cable trays, structural steel, handrails, and buried and nonaccessible connections.
   c. Provide bolted clamp type mechanical connectors for all exposed secondary connections.
   d. Use bolted offset parapet bases or through-roof concealed base assemblies for air terminal connections.
   e. Provide interconnections with electrical and telephone systems and all underground water, gas, sewer, and process metal pipes.
   f. Provide electric service arrestor ground wire to building water main.

3.03 FIELD QUALITY CONTROL

A. Field Testing:

1. Isolate lightning protection system from other ground conditions while performing tests.

2. Resistance: Test ground resistance of grounding system by the fall-of-potential method.
   a. Test Resistance to Ground: Maximum 1 ohm.
   b. Install additional ground rods as required to obtain maximum allowable resistance.

3. Test Report:
   a. Description of equipment tested.
   b. Description of test.
   c. Test results.
   d. Conclusions and recommendations.
   e. Appendix, including appropriate test forms.
   f. Identification of test equipment used.
   g. Signature of responsible test organization authority.

END OF SECTION

SECTION 26 43 13
SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section of the Specifications describes the requirements for low voltage AC surge protective devices (SPDs 1Kv and less), to be furnished under other Sections of the Specifications.

B. All equipment described herein shall be submitted, and factory installed, as an integral part of equipment specified elsewhere in these Specifications.

C. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install surge protective devices (SPDs) in the MCC/power panel, control panels and field devices.

D. Provide surge protection devices to protect field instruments and equipment from the effects of transient surges caused by lightning and other electrical sources.

E. SPDs shall be installed at the following locations:

1. On 480 VAC power and neutral connections at the MCC or power panels.

2. On 120 VAC, 60Hz power connections to control panels.

3. On all analog signals at the control panel. Include surge protection at 24 VDC loop powered field instruments for wiring distances greater than 75 feet from the control panel. Include surge protection on all four-wire, 120 VAC field instruments.

4. On all discrete signals that have portions of interconnecting wiring located outside of protected buildings.

5. On all copper data lines that have portions of interconnecting wiring located outside of protected buildings.

1.02 RELATED WORK

A. Refer to Section 26 05 01 for related work and electrical coordination requirements.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 26 05 01, the following:

1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.

3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

B. Submittals for equipment specified herein shall be made as a part of equipment furnished under other Sections. Individual submittals for equipment specified herein will not be accepted and will be returned unreviewed. Unmarked cut sheets will cause rejection of the submittal and its return for revision.

C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will be returned unreviewed.

D. Submit catalog data for all items supplied from this specification Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc., enough to confirm that the SPD provides every specified requirement. Any options or exceptions shall be clearly indicated, with the reason for such deviations. Acceptance of any deviation will be at the sole discretion of the Owner/Engineer. Shop drawings, not so checked and noted, will be returned unreviewed.

E. The submittals shall include:

1. Dimensional drawing of each SPD type.

2. UL 1449 Third Edition Listing, Standard for Safety, Surge Protective Devices, documentation. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL).

3. UL 1283 Listing, Electromagnetic Interference Filters, documentation.

4. ANSI/IEEE C6241 and C6245, Category C3 (20kV-1.2/50, 10kA-8/20µs waveform) clamping voltage test results.

F. Operation and Maintenance Manuals.

1. Operation and Maintenance manuals shall include the following information:

a. Manufacturer’s contact address and telephone number for parts and service.

b. Instruction books and/or leaflets

c. Recommended renewal parts list

d. Record Documents for the information required by the Submittals above.

1.04 REFERENCE CODES AND STANDARDS

A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. Underwriters Laboratory (UL)

a. UL 1449 Third Edition – Surge Protective Devices

b. UL 1283 Electromagnetic Interference Filters

c. UL 497B, Protectors for Data Communications and Fire-Alarm circuits.

2. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)

a. ANSI/IEEE C62.41.2-2002 – IEEE Recommended Practice on Characterization of Surge Voltages in Low Voltage AC Power Circuits

b. ANSI/IEEE C62.45-2002 – IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

3. National Electrical Code NEC Article 285 - Surge Protective Devices

4. NEMA/ISCI – 109 Transient Overvoltage Withstand Test

5. I Institute of Electrical and Electronic Engineers (IEEE)

a. IEEE Std. 472/ANSI C37.90A Surge Withstand Capability Tests

6. IEC 255.4 Surge Withstand Capability Tests

B. City of Houston Electrical Code

C. All SPDs and their installation shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.

D. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.05 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The manufacturer of the SPD shall be the same as the manufacturer of the service entrance and distribution equipment in which the devices are installed and shipped. The protected electrical equipment, after installation of the SPD, shall be fully tested and certified to the following UL standards:

1. UL 67 - Panelboards.

2. UL 845 - Motor Control Centers.

3. UL 891 - Switchboards.

4. UL 1558 - Low Voltage Switchgear.

C. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

1.06 WARRANTY

A. Provide warrantees, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for three years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.07 MEASUREMENT AND PAYMENT

A. Refer to Section 26 05 01.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (480 VAC Power Type 1 and Type 2):

1. Phoenix Contact, VAL-MS 320/3+1.

2. Erico, TDS350TT277

3. Dehn, DG MU 3PY 480 4W+G

4. Approved equal.

B. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (120 VAC Power Type 3):

1. Erico, TDS1301TR150

2. Phoenix Contact, MAINS-PLUGTRAB PT 2-PE/S-120AC-ST

3. Dehn, DR M 2P 150

4. Approved equal.

C. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (24 VDC Analog Surge Protection - Control Panel):

1. Erico, UTB30SP

2. Phoenix Contact, MCR-PLUGTRAB PT 1x2-24DC-ST

3. Dehn, BXT ML4 BE 24

4. Approved equal.

D. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (24 VDC Discrete Surge Protection):

1. Erico, UTB30SP

2. Phoenix Contact, MCR-PLUGTRAB PT 2x1-24DC-ST

3. Dehn, BXT ML4 BD 24

4. Approved equal.

E. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (120 VAC Discrete Surge Protection):

1. Erico, UTB110DP

2. Phoenix Contact, MCR-PLUGTRAB PT 2x1VA-120AC-ST

3. Dehn, BXT ML4 BE 180

4. Approved equal.

F. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (24 VDC Power/Analog Surge Protection - Field Devices):

1. Erico, RTP3034

2. Phoenix Contact, SURGETRAB, S-PT-EX-24DC

3. Dehn, BXT ML4 BE 36

4. Approved equal.

G. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (120 VAC Power/24 VDC Signal Surge Protection - Field Devices):

1. Erico, MWE and TDS1301TR150
2. Phoenix Contact, BOXTRAB – BXT-N4X 4-WIRE
3. Dehn, 999.990-01
4. Approved equal.

H. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (Data Surge Protection - Ethernet):

1. Erico, LANRJ45C6
2. Phoenix Contact, DT-LAN-CAT.6
3. Dehn, DPA M CLE RJ45B 48
4. Approved equal.

I. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (Data Surge Protection – RS-485):

1. Erico, DEPRS42299D
2. Phoenix Contact, DT-UFB-485/BS
3. Dehn, BXT ML4 BD HF 5
4. Approved equal.

J. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (Surge Protection – Device Tester):

1. Erico, MGA TESTER
2. Phoenix Contact, CHECKMASTER
3. Dehn, DRC LC M3+
4. Approved equal.

2.02 SERVICE ENTRANCE AND DISTRIBUTION EQUIPMENT

A. General

1. All SPDs shall be internal to the equipment being protected. Externally housed SPDs will not be acceptable.

2. All SPDs shall be marked with a short-circuit current rating and shall meet or exceed the available fault current at the connection point.

3. UL 1449 Usage Classifications.

    a. Type 1 – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device and intended to be installed without an external overcurrent protective device.

    b. Type 2 – Permanently connected SPDs intended for installation on the load side of service equipment overcurrent device; including SPDs located at the branch panel.

    c. Type 3 – Point of utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, for example cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. The distance (10 meters) is exclusive of conductors provided with or used to attach SPDs.

4. Construction of Type 1 and Type 2.

    a. Fully Integrated Component Design: All the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together to achieve higher surge current ratings or other functionality will not be accepted.

    b. Overcurrent Protection: The unit shall contain thermally protected MOVs. The thermally protected MOVs shall have a thermal protection element packaged together with the MOV to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

    c. Maintenance Free Design: The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries are not acceptable. SPDs requiring any maintenance of any sort such as periodic tightening of connections are not acceptable.

    d. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules are not acceptable.

e. Electrical Noise Filter: Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.

f. Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

g. Power and ground connections shall be prewired within the protected equipment.

h. Local Monitoring: Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.

i. Surge Counter: The SPD shall indicate user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. To prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of two seconds to clear the surge count total. The ongoing surge count shall be stored in non-volatile memory or UPS backup.

j. Remote Monitoring: For remote monitoring, the SPDs shall provide the same discrete and analog signal and control functions as specified for local monitoring and the surge counter, to a terminal strip for outgoing connection to a PLC as shown on the Drawings. The functions shall be converted as specified for interface to the monitored equipment.

k. The voltage surge suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

l. SPD shall be Listed in accordance with UL 1449 Third Edition and UL 1283, Electromagnetic Interference Filters.

m. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449 Third Edition, Section 37.3.2 and 37.4 at the standard's highest short circuit current rating (SCCR) of 200 kA, including intermediate level of fault current testing.

n. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50µs, 10kA-8/20µs).

o. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems (7 Mode).

5. Construction of Type 3.

a. Fully Integrated Component Design: All the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together to achieve higher surge current ratings or other functionality will not be accepted.

b. Maintenance Free Design: The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries are not acceptable. SPDs requiring any maintenance of any sort such as periodic tightening of connections are not acceptable.

c. Electrical Noise Filter: Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.

d. Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

e. Power and ground connections shall be prewired within the protected equipment.

f. Local Monitoring: Visible indication of proper SPD connection and operation shall be provided. The indicator light shall indicate that the module is fully operable. The status of each SPD module shall be monitored on the front cover of the module.

g. SPD shall be Listed in accordance with UL 1449 Third Edition and UL 1283, Electromagnetic Interference Filters.

h. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50µs, 10kA-8/20µs).

B. Applications.

1. Service Entrance Rated Equipment (Type 1).

a. This applies to switchgear, switchboards, panelboards, motor control centers, and other devices installed as service entrance equipment where the SPD is to be permanently connected between the secondary of the service transformer and the line side of the service equipment overcurrent device.

b. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

c. The SPD shall be of the same manufacturer as the equipment.

d. The SPD shall be factory installed inside the equipment, at the assembly point, by the original equipment manufacturer.

e. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bars.

f. The SPD shall be connected through a UL approved disconnecting means. The disconnect shall be in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

g. The SPD shall be integral to the equipment as a factory standardized design.

h. All monitoring and diagnostic features shall be visible from the front of the equipment.

2. Distribution Equipment Applications (Type 2).

a. This applies to switchgear, switchboards, panelboards, motor control centers, and other non-service entrance equipment where the SPD is to be permanently connected on the load side of the equipment overcurrent device.

b. The SPD shall be of the same manufacturer as the equipment.

c. The SPD shall be included and mounted within the equipment by the manufacturer.

d. The manufacturer shall size and provide the overcurrent and disconnecting means for the SPD.

e. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

f. The SPD shall be located within the panelboard, unless otherwise shown on the Drawings. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

g. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

h. All monitoring and diagnostic features shall be visible from the front of the equipment.

3. Individual Control Panel and Related Equipment Protection (Type 3).

    a. Locate the SPD on the load side of the ground and neutral connections.

    b. The SPD shall be connected through a disconnect circuit breaker or fuse as shown on the drawings. The disconnecting means shall be in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

    c. All monitoring and diagnostic features shall be visible from the front of the equipment.

4. Mechanical Equipment Manufacturer's Provided Control Panels (MEMs) and Electrical Manufacturer's Provided Control Panels (OEMs) Applications (Type 1, Type 2, and Type 3)

    a. Where any such panel is installed as service entrance equipment, a Type 1 SPD shall be installed.

        1) The same requirements for other service entrance equipment listed above apply to this application except for the requirement that the Type 1 SPD shall not be required to be of the same manufacturer as the panel.

    b. Where any such panel is installed as non-service entrance equipment, but within 50' of wire length of the incoming power line when that line is overhead.

        1) The same requirements for other non-service entrance equipment listed above apply to this application except for the requirement that the Type 2 SPD shall not be required to be of the same manufacturer as the panel.

        2) Where a Type 1 SPD is installed, a Type 2 SPD is not required on the same panel unless otherwise specifically shown on the drawings.

    c. Where any such panel includes a PLC, a Type 3 SPD shall be installed.

        1) The same requirements for other individual control panel and related equipment listed above apply to this application.

        2) The SPD shall be integral to the MEM or OEM panel, as a factory standardized design.

C. Ratings

1. Unit Operating Voltage: Refer to drawings for operating voltage and unit configuration.

2. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.

3. Minimum surge current rating shall be 240 kA per phase (120 kA per mode) for service entrance and 120 kA per phase (60 kA per mode) for distribution applications.

4. UL 1449 clamping voltage must not exceed the following: Voltage Protection Rating (VPR)

Voltage	L-N	L-G	N-G
240/120	1200/800V	800V	800V
208Y/120	800V	800V	800V
480Y.277	1200V	1200V	1200V
600Y/347	1500V	1500V	1500V

5. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE Category C High transients without failure or degradation of clamping voltage by more than 10%.

6. Minimum UL 1449 3rd edition withstand Nominal Discharge Current (In) rating to be 20kA per mode.

2.03 SPARE PARTS

A. Provide the following control system network component spare parts:

1. One per five of each type of surge protective device; minimum of one of each type of surge protective device.

2.04 ACCESSORIES

A. Furnish nameplates for each device as indicated on drawings. Color schemes shall be as indicated on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. All equipment specified herein shall be factory installed, field adjusted, tested, and cleaned as an integral part of equipment specified elsewhere in the individual equipment Specification.

B. Types 1 and 2 shall be grounded and bonded as a part of the individual equipment as specified in the individual equipment Section. Type 3 shall be grounded and bonded in accordance with the SPD manufacturer's instructions.

C. Conductor length between suppressor and connection point shall be as short and as straight as possible.

D. Upon completion of installation, provide the services of a factory-certified local service technician to perform start-up testing. Record test results and compare to factory testing to confirm proper operation of equipment. Submit test results with operation and maintenance manuals.

END OF SECTION

SECTION 26 8310
FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Fire-alarm control unit.
   2. Manual fire-alarm boxes.
   3. System smoke detectors.
   4. Heat detectors.
   5. Notification appliances.
   6. Addressable interface device.
   7. Digital alarm communicator transmitter.

1.03 DEFINITIONS

A. ADA: Americans with Disabilities Act.
B. FACP: Fire alarm control panel.
C. LED: Light-emitting diode.
D. NICET: National Institute for Certification of Engineering Technologies.
E. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.04 SYSTEM DESCRIPTION

A. Non-coded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.05 SUBMITTALS

A. General Submittal Requirements:
   1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect. Include comments from authorities having jurisdiction in submittal package to Architect.
   2. Shop Drawings shall be prepared by persons with the following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
      b. NICET-certified fire-alarm technician, Level III minimum.
      c. Licensed or certified by authorities having jurisdiction, if required.
B. Product Data: For each type of product indicated.
C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include detailed system operation description for this Project, including method of operation and supervision of each type of circuit and Sequence of Operations Matrix for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
3. Include system riser diagram with device address, conduit sizes, and cable and wire types and sizes.
4. Include wiring diagrams for power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
5. Include voltage drop calculations for notification appliance circuits.
6. Include battery-size calculations.
7. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
8. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
9. Include voice/alarm signaling-service equipment rack or console layout grounding schematic, amplifier power calculation, and single-line connection diagram.
10. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Qualification Data: For qualified Installer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
   2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
   3. Record copy of site-specific software.
   4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
      a. Frequency of testing of installed components.
      b. Frequency of inspection of installed components.
      c. Requirements and recommendations related to results of maintenance.

d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

G. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.

C. Electrical Components, Devices and Accessories: Listed and labeled as defined by NFPA 70, by a qualified testing agency, and marked for indeed location and application.

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company or as required by authorities having jurisdiction.

1.07 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.08 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no less than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount of each type installed, but no less than one unit of each type.
3. Smoke Detectors, Heat Detectors: Quantity equal to 10 percent of amount of each type installed, but no less than one unit of each type.

4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no less than one unit of each type.
5. Keys and Tools: One extra set for access to locked and tamper-proofed components.
6. Audible and Visual Notification Appliances: Two of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or engineer approved equal:

1. FACP Equipment and Devices:
   a. Silent Knight
   b. Notifier
   c. FireLite
   d. EST
   e. Siemens

2. Cellular Dialer:
   a. DSC 3G4010 V4.0/LE4010 V5.0 (or equal)
3. Wire and Cable:
   a. Comtran Corporation.
   b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
   c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
   d. West Penn Wire/CDT; a division of Cable Design Technologies.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Verified automatic alarm operation of smoke detectors.
6. Automatic sprinkler system water flow.

B. Fire-alarm shall initiate the following actions:

1. Continuously operate alarm notifications appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.

8. Activate stairwell pressurization systems.
9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
10. Activate emergency lighting control.
11. Record events in the system memory.
12. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or single break in fire-alarm control unit internal circuits.
5. Abnormal 1 ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of batter charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the even on system printer.

2.03 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.
2. Addressable initiation devices that communicate device identity and status.
Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
a. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 2 lines of 40 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:
   1. Initiating Device, Notification Appliance, and Signaling Line Circuits, NFPA 72, Class B, unless indicated otherwise.
      Initiating Device Circuits: Style B, unless indicated otherwise.
      a. Notification Appliance Circuits: Style Y, unless indicated otherwise.
      b. Signaling Line Circuits: Style 4, unless indicated otherwise.
      c. Install no more than 50 addressable devices on each signaling line circuit.

D. Serial Interfaces: Two RS-232 ports for printers.

E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

F. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and printout the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.

I. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals, supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24-V dc source.
   1. Alarm current draw of entire f ire- alarm system shall not exceed 80 percent of the power-supply module rating.

K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
   1. Batteries: Sealed lead calcium.

L. Surge Protection:

1. Install surge protection on normal ac power for the FACP and its accessories.
2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless –steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.04 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.05 SYSTEM SMOKE DETECTORS

A. General Requirement for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc; nominal
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicated detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    a. Rate-of-rise temperature characteristics shall be selectable at fire-alarm control unit of 15 to 20 deg F per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detector: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.06 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
   1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.07 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word “FIRE” is engraved in minimum 1-inch-high letters on the lens.
   1. Rated Light Output: 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.
   6. Mounting Faceplate: Factory-finished, red.

2.08 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal, including:
   1. To circuit-breaker shunt trip of power shutdown.

2.09 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by manufacturer device.
   2. Finish: Paint of color to match the protected device.

2.010 WIRE AND CABLE

A. Wire and cable for the fire-alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service. UL listed as TYPE FPL, and complying with requirements in UL 1424 and UL 2196 for a 2-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   1. Low-Voltage Circuits: No. 14 AWG, minimum.
   2. Line-Voltage Circuits: No 12 AWG, minimum.
   3. Multi-Conductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/THHN conductor insulation, copper drain wire, copper armor (with outer jacket where required) with red identifier stripe, UL listed for fire alarm and cable try installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting for Wall-Mounted Units: Install fire-alarm control unit on walls with tops of cabinets not more than 72 inches above the finished floor.

C. Smoke- or Heat-Detector Spacing:
   1. Comply with NFPA 72, Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
   2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
   5. HVAC: Locate detectors not closer than three feet from air-supply diffuser on return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

E. Signaling Line Circuits: Install no more than 50 addressable devices on each signaling line circuit.

F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm-Indicating Devices: Install at least 6 inches below the ceiling. Install on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
H. Visible Alarm-Indicating Devices: Install at least 6 inches below the ceiling.
I. Device Location-Indicating Lights: Locate in public space near the device they monitor.
J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
K. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.02 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hard and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than three feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to stairwell pressurization systems.
   2. Smoke dampers in air ducts of designated air-conditioning duct systems.
   3. Alarm-initiating connection to activate emergency lighting control.
   4. Supervisory connections at valve supervisory switches.
   5. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
   6. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.

3.03 WIRING INSTALLATION

A. Install wiring according to the following:
   1. NECA 1.
   2. TIA/EIA 568-A.
B. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways and Boxes."
   1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.05 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.06 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 26 8310

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SECTION 27 0000
COMMUNICATIONS BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes general administrative and procedural requirements for Division 27 and 28, and is intended to supplement, not supersede, the requirements specified in Division 01.

B. General Contractor responsible for coordination of responsibilities between Division 26, 27, and 28 contractor scope. Refer to decision matrix for additional information.

C. Provide completely functioning communications systems.

D. Comply with FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

E. The requirements described herein include the following:

1. References
2. Definitions
3. Submittals
4. Quality Assurance
5. Delivery, Storage, and Handling
6. Scheduling
7. Warranty
8. Product Substitutions
9. Project Management and Coordination Services
10. Permits and Inspections
11. Field Quality Control
12. Project Closeout and Record Documents

F. Related Items

1. General and Supplementary Conditions: General provisions of Contract and Division 01 apply to Division 27.
2. Consult other Divisions and Sections, determine the extent and character of related work, and coordinate Work of Division 27 with that specified elsewhere to produce a complete and operable installation.

1.02 RESPONSIBILITY MATRIX

CFOI – Contractor furnished/Owner installed
CFCI – Contractor furnished/Contractor installed
VFCI – Vendor furnished/Contractor installed
OFCI – Owner furnished/Contractor installed
OFVI – Owner furnished/Vendor installed
OFOI – Owner furnished/Owner installed

VFVI – Vendor furnished/Vendor installed

CoWU Wastewater Treatment Improvements - Design, Furnish and Install												
SYSTEM / COMPONENT	DESIGN BY	FURNISH / INSTALL										
		CFOI	CFCI	VFCI	OFCI	OFVI	OFOI	VFVI	CONTRACTOR ROUGH-IN	CONTRACTOR TIE-IN		
Owner Systems / Items												
Office Equipment	OWNER						•		•			
Computer, data processing equipment	OWNER						•		•			
A/V & Sound System Equipment	See Below						•		•			
Telephone System	OWNER						•		•			
Security/Access Control System	See Below											

CoWU Wastewater Treatment Improvements - Design, Furnish and Install

SYSTEM / COMPONENT	DESIGN BY	FURNISH / INSTALL								
		CFOI	CFCI	VFCI	OFCI	OFVI	OFOI	VFVI	CONTRACTOR ROUGH-IN	CONTRACTOR TIE-IN
TECHNOLOGY										
Pathway										
Cable Tray	Architect/Engineer(A/E)		•							
Horizontal Ladder Tray	A/E		•							
Backbone Conduit	A/E		•							
Horizontal Conduit	A/E		•							
Back Boxes	A/E		•							
Floor Cores	A/E		•							
Poke-thrus	A/E		•							
Firestop	A/E		•							
Entrance Facility / Equipment Room										
Plywood Walls	A/E		•							
Ladder Tray	A/E		•							
Grounding Bus Bar	A/E		•							
Equipment Racks/Cabintes	A/E		•							
Vertical Wire Managers	A/E		•							
Bonding Wire and Lugs	A/E		•							
Dedicated Power to Racks	A/E		•							
Convenience power on Walls	A/E		•							
PDU's	A/E		•							
Cabling										
Backbone Fiber	A/E		•							
Backbone Copper	A/E		•							
Backbone Coax	A/E		•							
Horizontal Fiber	A/E		•							
Horizontal Copper	A/E		•							
Horizontal Coax	A/E		•							
Cross Connect	A/E		•							
Coaxial Cable	A/E		•							
Termination Hardware										
Outlets/Jacks	A/E		•							
Copper Patch Panels	A/E		•							
Fiber LIU	A/E		•							
Copper Patch Cords	A/E		•							
Fiber Patch Cords	A/E		•							
Coax amps/Splitters	A/E		•							
Equipment										
Rack Mount UPS/Central UPS	OWNER						•			
Network Switches	OWNER						•			
Access Points and Controller	OWNER						•			
PCs / Laptops	OWNER						•			
Printers/Copiers/Faxes	OWNER						•			
Telephones	OWNER						•			
Telephone System	OWNER						•			

CoWU Wastewater Treatment Improvements - Design, Furnish and Install

SYSTEM / COMPONENT	DESIGN BY	FURNISH / INSTALL								
		CFOI	CFCI	VFCI	OFCI	OFVI	OFOI	VFVI	CONTRACTOR ROUGH-IN	CONTRACTOR TIE-IN
A/V & Sound System Equipment										
Pathway										
Cable Tray	A/E		•							
Conduit	A/E		•							
Back Boxes	A/E		•							
Floor Cores	A/E		•							
Poke-thrus	A/E		•							
Firestop	A/E		•							
Cabling										
Video	A/E		•							
Audio	A/E		•							
Control	A/E		•							
Termination Hardware										
Outlets	A/E		•							
Connectors	A/E		•							
Patch Cords	A/E		•							
Equipment										
Speakers	A/E							•		
Amplifiers	A/E							•		
Microphones	A/E							•		
Room Controls	A/E							•		
Conference Camera	A/E							•		
Flat Panel Displays	A/E							•		
Flat Panel Mount	A/E							•		
Wireless Connectivity (Airmedia)	A/E							•		
Video Switchers	A/E							•		
Media Converters	A/E							•		

CoWU Wastewater Treatment Improvements - Design, Furnish and Install												
SYSTEM / COMPONENT	DESIGN BY	FURNISH / INSTALL										
		CFOI	CFCI	VFCI	OFCI	OFVI	OFOI	VFVI	CONTRACTOR ROUGH-IN	CONTRACTOR TIE-IN		
Security/Access Control System												
Pathway												
Conduit	A/E		•									
Back Boxes	A/E		•									
Penetrations	A/E		•									
Firestop	A/E		•									
Cabling												
Camera Network Cabling	A/E		•									
PTZ Power	A/E		•									
Access Control	A/E		•									
Panic Buttons	A/E		•									
Connection to Existing Security	A/E		•									
Connection to Fire Alarm	A/E		•									
Fiber to Copper Injectors	A/E		•									
Termination Hardware												
Outlets	A/E		•									
Patch Panels	A/E		•									
Equipment												
Cameras/Housing/Mounts	A/E							•				
Card Readers	A/E		•									
Door Contacts	A/E		•									
REX Devices	A/E		•									
Network Interface	OWNER						•					
Access Controllers	A/E		•									
NVR Storage	OWNER						•					
POE Network Switches	OWNER						•					
Monitors	OWNER		•									
Silent Alarm	A/E		•									
Security UPS	OWNER						•					
Intrusion System Devices	A/E		•									

1.03 REFERENCES

A. General

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.
2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards

subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform Work and furnish materials and equipment under Division 27 in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
   1. United States Department Of Labor (DOL) Occupational Safety and Health Administration (OSHA) Regulations (Standards - 29 CFR)
      a. Part 1910, “Occupational Safety and Health Standards”
      b. Part 1926, “Safety and Health Regulations for Construction”
   2. Texas Accessibility Standards (TAS)
   3. Texas Administrative Code
   4. National Fire Protection Agency (NFPA) 101 (Life Safety Code)
   5. Code of Federal Regulations (CFR) Title 47 “Telecommunication”, Chapter I “Federal Communications Commission (FCC)”:
      a. Part 15, Radio Frequency Devices & Radiation Limits
      b. Part 24, Personal Communications Services
      c. Part 27, Miscellaneous Wireless Communications Services
      d. Part 68, Connection of Terminal Equipment to the Telephone Network
   6. National Fire Protection Agency (NFPA)
      a. NFPA 70, “National Electrical Code” (NEC)
      b. NFPA 75, “Protection Of Information Technology Equipment”
      c. NFPA 262, “Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces”,
   7. Other national, state, and local binding building and fire codes

C. Standards: Perform Work and furnish materials and equipment under Division 27 in accordance with the latest editions of the following standards as applicable:
   1. Underwriter's Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
      a. UL 444, “Communications Cables”
      b. UL 497, “Protectors for Paired-Conductor Communication Circuits”
      c. UL 497A, “Secondary Protectors for Communications Circuits”
      d. UL 497B, “Protectors for Data Communications and Fire-Alarm Circuits”
      e. UL 1651, “Optical Fiber Cable”
      f. UL 1666, “Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts “
      g. UL 1690, “Data-Processing Cable “
      h. UL 1963, “Communications-Circuit Accessories”

i. UL 2024A, “Optical Fiber Cable Routing Assemblies”

2. ANSI/TIA/EIA-568 Series:
   a. “ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises, Ed. D, 09-2015”
   b. “ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard, Ed. D, 09-2015”
   c. ANSI/TIA-568-C.2, “Balanced Twisted-Pair Telecommunication Cabling and Components Standard, Ed. C, Err. 04-2014”
   d. ANSI/TIA-568.3-D, “Optical Fiber Cabling And Components Standard, Ed. D, 10-2016”
   e. ANSI/TIA-568-C.4, “Broadband Coaxial Cabling and Components Standard, Ed. C, 07- 2011”
3. ANSI/TIA-569-B, “Commercial Building Standard for Telecommunications Pathways and Spaces”
4. ANSI/TIA/EIA-598, “Optical Fiber Cable Color Coding”
5. ANSI/TIA/EIA-606-A, “Administration Standard for Commercial Telecommunications Infrastructure”
6. ANSI/J-STD-607-A, “Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications”
7. ANSI/TIA/EIA-758, “Customer-Owned Outside Plant Telecommunications Cabling Standard”, including the following addenda”
8. ANSI/TIA-1005, “Telecommunications Infrastructure Standard for Industrial Premises”
9. EIA testing standards
10. Insulated Cable Engineers Association (ICEA):
    a. ANSI/ICEA S-80-576-2002, “Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems”
    b. ANSI/ICEA S-83-596-1994, “Fiber Optic Premises Distribution Cable”
    c. ANSI/ICEA S-87-640-1999, “Fiber Optic Outside Plant Communications Cable”
    d. ANSI/ICEA S-90-661-2002, “Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems”
    e. ICEA S-102-700-2004, “ICEA Standard For Category 6 Individually Unshielded Twisted Pair Indoor Cables (With Or Without An Overall Shield) For Use In Communications Wiring Systems Technical Requirements”
    f. ICEA S-104-696-2001, “Indoor-Outdoor Optical Cable”
11. Building Industry Consulting Services International (BICSI) :
    a. Telecommunications Distribution Methods Manual (TDMM)
    b. Customer-Owned Outside Plant Design Manual
    c. Wireless Design Reference Manual (WDRM)
    d. Network Design Reference Manual (NDRM)
12. IEEE-802 – Standards
    a. IEEE-802.3af Power Over Ethernet (PoE) Standard

b. IEEE-802.3af Power Over Ethernet + (PoE+) Standard
c. IEEE-802.3an Physical Layer and Management for 10Gbps – 10BASE-T
d. IEEE-802.11 Wireless Standard

D. Make a copy of each document readily available during the course of construction for reference by field personnel.

1.04 DEFINITIONS

A. The Definitions of Division 01 shall apply to Division 27 sections.
B. In addition to those Definitions of Division 01, the following list of terms as used in this specification defined as follows:
1. "As directed": As directed or instructed by the Owner, or their authorized representative
2. "Cabling": A system comprised of cables, wire, cords, and connecting hardware [e.g., cables, termination apparatus, patch panels, blocks, connectors, outlets, labeling, etc]
3. "Connect": To install required patch cords, equipment cords, crossconnect wire, etc. to complete an electronic or optical signal circuit
4. "Cord": a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead"
5. "Engineer": MEPCE
6. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories
7. "General Contractor": Manhattan/Byrne/3i
8. "Identifier": A unique code assigned to an element of the Telecommunications infrastructure that links it to its corresponding record
9. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation
10. "Owner/Owner's Representative": Weatherford
11. "Pigtail": a length of cordage having connectors at one end
12. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation

1.05 SYSTEM DESCRIPTION AND PROJECT CONDITIONS

A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

1.06 SUBMITTALS

A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.
B. Failure to comply with requirements in part or whole shall constitute grounds for rejection.
C. Submittal Description: Product Data

1. Obtain written approval from the Engineer for the product data submittal prior to materials and equipment purchase order and prior to installation.
2. Quantity: Submit product data as described in Division 01. In the absence of requirements given, submit four product data submittals.
3. Format:
   a. Submit each product data on letter size (8.5" x 11") paper.
   b. Package product data using a 3-ring binder, plastic cover, or similar.
   c. Clearly label the cover and spine of each submittal with the following information (e.g., if in a 3-ring binder, insert the submittal information in the transparent front cover and spine pockets):
      1) Client Name
      2) Project Name and Address
      3) Project Submittal Number
      4) Submittal Name
      5) Specification Section Number
      6) Date of Submittal. Format: Month Day, Year
      7) Contractor Name
   d. Include a Table Of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., "2.02 Equipment Racks").
   e. Include tabbed separators for improved navigation through the submittal.
4. Content:
   a. Cover Letter: Include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Sign (and stamped, if applicable) cover letter and list items and data submitted.
   b. Product Information: Include manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) to clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in Division 27. Include relevant products that will be installed, which are not listed in the specifications.
   c. Resubmittals: Provide a cover letter with the resubmittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. No review shall take place for any resubmittal packages that is not accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.

D. Submittal Description: Shop Drawings

1. Prior to the start of work, submit shop drawings and obtain written approval from the Engineer for the shop drawings submittal.
2. Provide cable pulling plan in addition to other required shop drawings.
3. Quantity and Media: Submit shop drawings as described in Division 01. In the absence of requirements given, submit four full-size sets of shop drawings on bond or “eco-bond”.
4. Format:
   a. Produce shop drawings using AutoDesk Revit, or other computer design application that can save files to AutoDesk Revit-compatible files.
   b. Use the same sheet size as the drawings of the Contract Documents.
   c. Use the project’s title block – same as the drawings of the Contract Documents.
   d. Text: minimum of 3/32” high when plotted at full size.
   e. Use identical symbols as those in the drawings.
   f. Screen background information.
   g. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
   h. Label each sheet in the shop drawings set with the Specification Section Number (e.g., “271523”).
   i. Scaling:
      1) Scale floor plans at 1/8”=1’-0”
      2) Scale enlarged room plans at 1/4”=1’-0”
      3) Scale wall elevations at 1”=1’-0”
      4) Scale rack elevations at 1”=1’-0”
5. Content:
   a. Submit shop drawings if the proposed installation differs from the Contract Documents or the design intent.
   b. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the Contract Documents. Have the person who prepared the submittal sign (and stamped, if applicable) the cover letter and include a drawing index. Failure to comply with this requirement shall constitute grounds for rejection of submittal.
   c. Drawing Information: Shop drawing submittals shall consist of floor plans, enlarged room plans, wall and rack elevations, installation details, and other aspects of the system that differ from the Contract Documents or the design intent. Use the same scales as the Drawings (e.g., 1/4" = 1'-0" for enlarged room plans).
   d. Resubmittals: Accompany resubmittals with a cover letter that lists the revisions made to each drawing in response to Submittal Review Comments. Failure to include this cover letter will constitute rejection of the resubmittal package without review.

E. Submittal Description: As-Built Drawings

1. Quantity and Media: Submit as-built drawings as described in Division 01. In the absence of requirements given, submit one full-size set of shop drawings on bond or "eco-bond" and submit one set of electronic files on DVD-ROM.
2. Format:
   a. Produce as-built drawings using AutoDesk Revit, or other computer design application that can save files to AutoDesk Revit -compatible files.
   b. Use the same sheet size as the drawings of the Contract Documents.
   c. Use the project's title block – same as the drawings of the Contract Documents.
   d. Text: minimum of 3/32" high when plotted at full size.
   e. Use symbols identical to the symbols shown on the Drawings.
   f. Screen background information.
   g. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
3. Content:
   a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.
   b. Floor Plans: Scale floor plans at 1/8"=1'-0". Floor plans shall show:
      1) Locations and identifiers of telecommunications devices.
      2) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits 2" trade size or larger.,
   c. Rooms Drawings: Applicable rooms: EF, ER & TR. Room drawings shall show:
      1) Floor layouts – scaled at either 1/4"=1'-0" showing dimensioned placement of equipment cabinets/frames, rack bays, etc.
      2) Overhead layouts – scaled at either 1/4"=1'-0" showing dimensioned placement of overhead cable support (e.g., cable tray, cable runway, basketway, conduit sleeves, etc.)
      3) Rack elevations – scaled at 1"=1'-0", showing placement of termination apparatus and other equipment installed onto rack bays
      4) Wall Elevations – scaled at 1"=1'-0", showing dimensioned placement of termination apparatus (e.g., termination/crossconnect blocks)

F. Submittal Description: Operation and Maintenance (O&M) Manuals for Active Systems
   1. Quantity: Submit quantity of O&M Manuals as described in Division 01. In the absence of requirements given, submit four O&M Manuals.
   2. Format:
      a. Submit each O&M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.
      b. Clearly label the cover of each O&M Manual with the following information:
         1) Client Name
         2) Project Name and Address
         3) Manual Name (e.g., "Operation And Maintenance Manual for Telecommunications Cabling System")

4) Date of Submittal. Format: Month Day, Year (e.g., "January 1, 2010")
5) Contractor Name

c. Include a Table Of Contents at the beginning that lists the contents.
d. Include tabbed separators for improved navigation through the manual.

3. Content:
   a. Tabloid (17"x11") prints of as-built drawings, as described above
   b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)
   c. Warranty certificate from the manufacturer and the Contractor
   d. Manufacturer's instructions for system or component use
   e. Instructions and requirements for maintenance and warranty issues
   f. Contents shall include requirements and methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

G. Submittal Description: Operation and Maintenance (O&M) Manuals for Passive Systems
   1. Quantity: Submit quantity of O&M Manuals as described in Division 01. In the absence of requirements given, submit four O&M Manuals.
   2. Format:
      a. Submit each O&M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.
      b. Clearly label the cover of each O&M Manual with the following information:
         1) Client Name
         2) Project Name and Address
         3) Manual Name (e.g., "Operation And Maintenance Manual for Telecommunications Cabling System")
         4) Date of Submittal. Format: Month Day, Year
         5) Contractor Name
      c. Include a Table Of Contents at the beginning that lists the contents.
      d. Include tabbed separators for improved navigation through the manual.
   3. Content:
      a. Tabloid (17"x11") prints of as-built drawings, as described above
      b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)
      c. Warranty certificate from the manufacturer and the Contractor

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications
   1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.

2. Manufacturer(s) of products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the specifications are met. Include in the program, at a minimum, provisions for:
   a. Incoming inspection of raw materials
   b. In-process inspection and final inspection of the cable product
   c. Calibration procedures of test equipment to be used in the qualifications of the product
   d. Recall procedures in the event that out of calibration equipment is identified.
3. Conform to government standards on quality assurance for applications within these specifications.

B. Materials
1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials
2. Use specified products and applications, unless otherwise submitted and approved in writing.

C. Regulatory Requirements
1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 27 shall confirm to the most stringent of the applicable codes.
2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

D. Drawings
1. Follow the general layout shown on the Drawings except where other Work may conflict with the Drawings.
2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.
3. The Drawings do not fully represent the entire installation for the Communications System. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery
1. Do not deliver products to the site until protected storage space is available.
2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.

3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.
4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not to impact the construction schedule.

B. Storage and Protection
1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions (as recommended by manufacturer) and protected from exposure to harmful weather conditions.
2. Comply with manufacturer's storage requirements for each product. Comply with recommended procedures, precautions or remedies as described in the Material Safety Data Sheets (MSDS) as applicable.
3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
4. Storage outdoors covered by rainproof material is not acceptable.
5. Provide heat where required to prevent condensation or temperature related damage.

C. Handling
1. Handle materials and equipment in accordance with manufacturer's written instructions. Handle with care to prevent damage, breakage, denting, and scoring.
2. Do not install damaged materials and equipment. Replace damaged equipment at no cost to the Owner.

1.09 SCHEDULING

A. Unless otherwise specified, the construction schedules of the Sections within Division 27 may be combined into a single, overall schedule.
B. Do not proceed without written approval from the Owner or Owner’s Representative for schedule of this Work.

1.010 PROJECT MANAGEMENT AND COORDINATION

A. Project Management and Coordination Services
1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.
2. BIM Model Coordination:
a. Resolve conflicts with other trades during design assist phase of the projects. Obtain the assistance/approval of the engineer where the design deviates substantially from the contract drawings.

B. Concurrent Installation
1. The network will be installed concurrent with the work of Division 27. Coordinate your Work with the Owner’s/network integrator’s work. For example, coordinate scope and dates for rack and cabling (terminations) readiness to allow the network integrator to

plan and schedule installation of the network equipment (for example, access switches).

C. Role of the Engineer
   1. The Owner has retained the Engineer's services through construction. During construction, the Engineer will work with and assist the Contractor as follows:
      a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.
      b. Provide interpretation and clarification of project contract documents
      c. Reply to (and 'process') relevant Requests for Information (RFIs)
      d. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
      e. Interpret field problems for Owner, and translate between Owner and Construction Team.
      f. Review the testing procedures to confirm compliance with industry-accepted practices.
      g. Observe the work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system, and report progress to the Owner.

D. Use of CAD Files
   1. Should the Contractor require the Engineer's CAD files to produce shop drawings and/or as- built drawings, the Engineer requires the Contractor sign a CAD files release agreement.,

1.011 WARRANTY

A. Warrant products and labor provided will, under normal use and service, be free from defects and faulty workmanship for period of 5 years from the date of acceptance. During the warranty period the entire system shall be kept in operating condition at no additional material or labor costs to the Owner.

B. Render service within two business days of system failure notification. Note deviations or improvements to this service at the time of bid and obtain written acceptance from the Owner, or Owner's Representative.

C. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. Provide complete replacement parts within two business days during the warranty period.

D. Conformance to certain government standards on quality assurance may be required for some applications outlined in these specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.
B. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Engineer in writing prior to ordering the material and performing installation work.

2.2 PRODUCT SUBMITTAL AT TIME OF BID

A. At the time of bid, include a list of major products in the Contract documenting the intended cabling system solution. Examples of major products may include: horizontal cable, modular jacks, faceplates, modular patch panels, backbone cable, termination block systems, fiber connectors, fiber patch panels.

2.3 SUBSTITUTIONS

A. Conform to the general requirements and procedure outlined in Division 01 in the Request For Substitution.
B. Substitutions to be approved though MEPCE.
C. Only one substitution allowed for each product specified.
D. Where products are noted as "or equal", a product of equivalent design, construction, and performance will be considered. Submit product data – catalog cuts, product information, and pertinent test data –required to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.
E. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).
F. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.
G. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.

H. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

PART 3 - EXECUTION

3.1 PERMITS AND INSPECTIONS

A. Obtain and pay for permits and inspections required for the work.
B. Furnish materials and execute workmanship for this work in conformance with applicable legal and code requirements.
C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.
D. Arrange and pay for review/inspection from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

3.2 EXAMINATION

A. Verify existing conditions, stated under other sections, are acceptable for installation in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman to supervise the crew performing the work and who is present at the job site at times work is being performed.
B. Construction Meetings: Participate in construction coordination meetings throughout the course of construction to review the progress and to resolve issues and conflicts. Prepare and distribute meeting agenda for telecommunication issues prior to, and meeting notes after meetings, in a format acceptable to the Owner. Publish meeting notes within 3 business days following the meeting.
C. Scheduling: Perform the work within the approved construction schedule. Keep the construction schedule current, based on the results of the construction meetings. At minimum, schedule shall document critical due dates, tasks, and milestones. Submit revised schedules for approval within 3 business days whenever there are modifications.
D. Inspection: Inspect the work after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion and inspection as required.

3.4 INSTALLATION

A. Complete work in a neat, high-quality manner, relative to common industry practices, and in accordance to NECA “Standard of Installation”.
B. Complete work in conformance to applicable federal, state and local codes, and telephone standards.

C. Coordinate the entire installation throughout the construction team (general contractor and subcontractors).
D. Manufacturer's Instructions:
   1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
   2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite packaged with an MSDS.
E. Adjusting:
   1. Make changes and revisions to the system to optimize operation for final use.
   2. Make changes to the system such that defects in workmanship are corrected and cables and the associated termination hardware pass the minimum test requirements.
F. Protection
   1. Protect installed products and finish surfaces from damage during construction.
G. Repair/Restoration
   1. Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement.
   2. Repair defects prior to system acceptance.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused, excess, and left over products, debris, spills, or other excess materials. Remove installation equipment.
B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.
C. Repair or replace damaged installed products.
D. Legally dispose of debris.
E. Clean installed products in accordance with manufacturer's instructions prior to Owner's, or Owner’s Representative’s, final punch walk.

3.6 FINAL INSPECTION AND CERTIFICATION

A. Punch Walks and Punch Lists
   1. Punching the Work of individual Sections of Division 27 may be combined.
   2. Execute a punch walk with the Engineer and the Owner or Owner’s Representative to observe Work.
   3. Develop a punch list for items needing correction. Issue this punch list to Engineer.
   4. Correct the Work as noted on punch list.
   5. Execute follow up punch walk with the Engineer and the Owner or Owner’s Representative to verify punch list items have been corrected.
B. System Acceptance
   1. Complete corrections (punch list items) prior to submitting acceptance certificate.
   2. On completion of the acceptance test, submit system acceptance certificate to the Owner or Owner’s Representative requesting their signature and return of the

certificate. Issue copies of the signed certificate back to the Owner or Owner's Representative with copy to the Engineer.

C. Training
   1. After acceptance, schedule a time convenient with the Owner, or Owner's Representative, for instruction in the configuration, operation, and maintenance of the system.
   2. Provide 2 hours, minimum, UON in individual specification sections of on-site training by a factory-trained representative. Document dates and times of training, and submit a "sign in" sheet for individuals trained, as part of the close out documentation.

END OF SECTION 27 0000

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SECTION 27 0526
COMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Communications Grounding Backbone and bonding of communications infrastructure and equipment to Communications Grounding Backbone.

B. Related Sections
   1. Comply with the Related Sections requirements of Section 27 00 00.

1.02 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

B. In particular or addition to the codes and standards listed in Section 27 00 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. NFPA 70, “National Electrical Code”, particularly the following Articles:
      a. Article 250: Grounding
      b. Article 770: Optical Fiber Cables and Raceways
      c. Article 800: Communications Systems
      d. Article 810: Radio and Television Equipment
      e. Article 820: Community Antenna Television and Radio Distribution Systems
   2. Underwriters Laboratories, Inc. (UL) UL 467: Grounding and Bonding Equipment
   3. Electronic Industries Association/Telecommunication Industry Association:
      a. ANSI-J-STD-607-A-2002, “Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications”
      b. ANSI/TIA/EIA-606-A-2002, “Administration Standard for Commercial Telecommunications Infrastructure”
   4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. IEEE 467, “IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems”
      b. IEEE P1100, “IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems”

1.03 DEFINITIONS

A. Definitions as described in Section 270000 shall apply to this section.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
   1. “BCT”: Bonding Conductor for Telecommunications
   2. “CM” and “cmil”: Circular Millionths of an inch

3. “GE”: Grounding Equalizer Conductor
4. “MBRGB”: Main Building Reference Grounding Busbar
5. “TBB”: Telecommunications Bonding Backbone
6. “TBC”: Telecommunications Bonding Conductor
7. “TGB”: Telecommunication Grounding Busbar
8. "THHN”: Thermoplastic High Heat-resistant Nylon-coated
9. “TMGB”: Telecommunication Main Grounding Busbar

1.04 SYSTEM DESCRIPTION

A. Base Bid Work: The Work under this section includes furnishing materials, installation, and coordination through the General Contractor with other trades for a Communications Grounding Backbone and for bonding of telecommunications equipment and apparatus to the Communications Grounding Backbone.

B. Communications Grounding Backbone System: The Communications Grounding Backbone System contains grounding busbars, grounding conductors, bonding conductors, and connecting devices (including but not limited to pressure connectors, lugs, clamps, or exothermic welds). These components, upon completion of installation and testing, shall provide the means of a low impedance path to earth for unintentional and/or stray voltages or spurious signals present on telecommunications media and equipment. The Communications Grounding Backbone System will consist of the following aspects in addition to the grounding requirements in the electrical plans.

1. TMGB: Locate the TMGB in the EF with the following connections:
   a. MBRGB, via BCT
   b. Each TBB
   c. Ground bushings installed on each entrance conduit opening within the space, via TBC
   d. Overhead cable support within the space, via TBC
   e. Dedicated power panel’s ACEG within the space serving communication equipment, via TBC
   f. Metallic pathways (conduits, surface raceway, etc.) within the space, via TBC
2. TBB: TBB(s) are the primary bonding conductor between the TMGB and other TGBs provided throughout a single building. The length of TBBs shall not exceed 500 feet. The TBB shall route from the EF through each of the TRs bonding each of the TGBs to the TMGB. Maintain TBB continuity and do not break continuity in order to bond to a TGB.
3. GE: GE(s) are bonding conductors between TGBs (or other elements of the grounding backbone) on a common floor. The length of GEs shall not exceed 500 feet. One GE shall occur every three floors. Maintain GE continuity.
4. TGB: Locate the TGB in each TR with the following connections:
   a. TBB
   b. Building steel, via TBC

c. Each entrance conduit into the space, via TBC and ground bushings
d. Overhead cable support within the space,, via TBC
e. Panelboard's ACEG within the space serving telecommunication equipment, via TBC
f. Metallic pathways (conduits, surface raceway, etc.) within the space, via TBC

C. Performance Criteria for the Grounding Backbone:
1. Resistance from any point of the communication grounding backbone system to the ground electrode and to earth shall not exceed 20 Ohms.
2. Field test resistance and document, both electronically and printed, measured values.

D. Bonding: Bonding consists of TBCs within telecommunications rooms from the TMGB and TGBs to the following components:
1. Rack bay
2. Overhead cable support and vertical cable support
3. Wall-mounted termination equipment
4. Conduit ground bushings
5. Exit pathways
6. Bonding jumpers between basketway, cable runway, and cable tray joints & splices, and between basketway/cable runway/tray and equipment racks. Note: Bonding jumpers are not required if tray splices are UL listed as a grounding conductor.

E. Conductor Gauge Criteria:
1. Size BCT as the greater of either 2,000 cmil per linear foot up to 3/0 AWG or the largest TBB.
2. Size TBB, GE, and TBCs as 6 AWG minimum, then as 2,000 cmil per linear foot up to 3/0 AWG.

1.05 SUBMITTALS

A. Comply with Submittal procedural, quantity, and format requirements of Section 27 00 00.

B. Submittal Requirements at Start of Construction:
1. Product Data Submittal
2. Shop Drawing Submittal(s), if the Contractor's installation intent differs from the Contract Documents or the deign intent

C. Substitutions
1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 27 00 00.

D. Submittal Requirements at Closeout: Submit to the Owner at the time of project closeout the following and before certificate of final payment is issued.
1. Test Report: Submit computer-generated test records of measured resistance values for inclusion into the Operation and Maintenance Manual.

2. As-Built Drawings, consisting primarily of the Communications Grounding Backbone (not necessarily each bonded component or apparatus)

1.06 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 27 00 00.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 27 00 00.

1.08 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 5 years. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Application: Suitable for indoor installation as a BCT, TBB, GE, and/or TBC.
B. Type: THHN (or THWN)
C. Conductor: 1/C, annealed copper, stranded
D. Gauge: Refer to conductor sizing criteria.
E. Insulation: thermoplastic/nylon or similar, green in color
F. Flame Resistance: Meet the flame resistance requirements of IEEE 383, CSA FT-4 and UL VW-1.
G. Print on the Insulation: insulation grade, conductor gauge, and applicable UL jacket listings.

2.2 SPLICE

A. Application: High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections.
B. Manufacturers:
   1. Panduit
      a. #HTCT250-250-1; “H-type” compression splice for #2 – 250MCM AWG
   2. Thomas & Betts
      a. #53000 series
   3. Or equal

2.3 CONNECTOR – “PARALLEL” TAP

A. Application: H-type thick wall compression tap, for making conductor–to–conductor (e.g., TBB-to-TBC) permanent connection (pig tailing, tapping, or splicing). Connectors shall be UL Listed.
B. Manufacturers:
   1. Panduit

a. #HTCT2-2-1; “H-type” compression tap, run = #6-#2, tap = #2-#6.
b. #HTCT250-2-1; “H-type” compression tap, run = #2-250MCM, tap = #6-#2

2. Or equal

2.4 CONNECTOR – “C” TAP

A. Application: C-type copper thick wall compression tap, for making conductor–to–conductor (e.g., TBB-to-TBC) permanent connection (pigtailing, tapping, or splicing). Connectors shall be UL Listed.
B. Manufacturer:
1. Panduit
a. #CTAPF4-12-C; CTAP for #6 AWG run –to– #6 AWG tap
b. #CTAPF2-12-C; CTAP for #2 AWG run –to– #6 AWG tap
c. #CTAPF1/0-12-L; CTAP for 1/0 AWG run –to– #6 AWG tap
d. #CTAPF2/0-12-Q; CTAP for 2/0 AWG run –to– #6 AWG tap
e. #CTAPF3/0-12-Q; CTAP for 3/0 AWG run –to– #6 AWG tap
2. Or equal

2.5 GROUNDING BUSBAR - TINNED

A. General: Busbar shall be UL listed.
B. Standards: Compliant to ANSI-J-607-A
C. Material: Solid copper, tinned cladding
D. Holes: Predrilled, compatible with standard NEMA bolt hole sizing and spacing and with ANSI-J-607-A recommendations for 2-hole lugs.
E. Mounting: Wall-mounted with standoffs. Standoffs shall insulate busbar from the mounting substrate.
F. Manufacturer:
1. Panduit
a. # GB4B0624TPI-1; busbar, 20”L x 4”W x ¼”T, TMGB hole pattern
2. Or equal

2.6 CONNECTION TO STRUCTURAL STEEL

A. Application: Exothermic welds shall be used for cable-to-cable, cable-to-ground rod, and cable-to-structural steel.
B. Manufacturers:
1. Cadweld
a. Each particular type of weld shall use a kit unique to that type of weld
2. Or equal

2.7 CONNECTOR – COMPRESSION LUG

A. Application: Conductor-to-busbar and/or –rack (or other flat surfaces) connection
B. Type: compression lug, standard or long barrel, two-hole (1/4 inch diameter 5/8 inch on center)

C. Manufacturers:
   1. Panduit
      a. #LCC6-14JAW-L; for 6 AWG conductor
      b. #LCC4-14ADW-L; for 4 AWG conductor
      c. #LCC2-14AW-Q; for 2 AWG conductor
      d. #LCC1-14AW-E; for 1 AWG conductor
      e. #LCC1/0-14AW-X; for 1/0 AWG conductor
      f. #LCC2/0-14AW-X; for 2/0 AWG conductor
   2. Or equal

2.8 CONNECTOR – SPLIT-BOLT, MECHANICAL TYPE

A. Application: Conductor-to-conductor (or other round component) connection
B. Type: split-bolt mechanical connector, for #6 to #3 conductor
C. Material: high-strength copper alloy
D. Manufacturers:
   1. Panduit
      a. #SBC3-C
   2. Or equal

2.9 GROUND BUSHING

A. Refer to for ground bushing requirements.
B. Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.
C. Manufacturers:
   1. OZ/Gedney BLG
   2. Thomas & Betts #TIGB series
   3. Or equal.

2.10 LABELS

A. Labels for Busbars
   1. Labels shall be machine-printable (such as by a laser printer or hand-held printer)
   2. Printable Area: 2” x 0.5”, minimum.
   3. Color: White.
   4. Manufacturer:
      a. Panduit
         1) #C200X100FJJ; laser/ink jet labels for busbars, white
      b. Or equal
B. Labels for Conductors
   1. Labels shall be machine-printable (such as by a laser printer or hand-held printer)
   2. Labels shall be adhesive-backed and have a self-laminating feature.
   3. Printable Area: 1 inch wide x 0.5 inch high, minimum
   4. Color: White.

5. Manufacturer:
    a. Panduit
        1) #S100X150YAJ; laser/ink jet labels for wire diameters 0.16” (#6) - 0.32” (#1/0), white
        2) # S100X225YAJ; laser/ink jet labels for wire diameters 0.24” (#2) - 0.48” (#3/0), white
    b. Or equal

2.11 MISCELLANEOUS

A. Wire Clamp
    1. Material: nylon, UV stabilized.
    2. Color: black
    3. Size: 0.25” holding diameter for 6 AWG; or size as required based on conductor size.
    4. Manufacturer:
        a. Richco Inc.
            1) #N4B-BLK
        b. Or equal

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with the Execution requirements of Section 27 00 00.
B. Work shall comply with the International Building Code, International Fire Code, National Electrical Code, UL 467, and ANSI-J-607-A standards, as well as local codes that may specify additional grounding and/or bonding requirements. If discrepancies between codes and/or standards arise, codes shall prevail, and then the more stringent requirement shall prevail, and as directed by the AHJ.
C. Install components to manufacturer’s instructions and recommendations and as required per UL listing.
D. Identify grounding and bonding conductors and components according to local codes.
E. Terminations must be accessible for inspection and maintenance during the life of the system.

3.02 EXAMINATION AND PREPARATION

A. Prior to the start of this section’s work, examine pathways and communications rooms for completeness, compatibility with the work of this section, and readiness for connections with the work of this section.

3.03 INSTALLATION

A. BCT, TBB, and GE Conductors
    1. Install BCT, TBB, and GE conductors in a manner to protect them from physical damage.

2. When routing BCT, TBB, or GE conductors through metallic conduit 3 feet or longer, bond the conductor to the conduit at both ends using a #6 AWG bonding conductor as a pigtail, an irreversible connection (preferably exothermic weld) for the conductor-to-pigtail connection, and insulated ground bushings at the conduit ends.
3. Install the BCT, TBB, or GE conductor without splices.
    a. In the event that a splice is necessary, notify the Project Manager in writing. Do not proceed with splicing work until the Project Manager has accepted in writing the installation of a splice.
    b. Locate the splice in a telecommunications space and ensure accessibility.
    c. Perform the splice using an exothermic weld and an irreversible compression- type connector.
4. Connect grounding conductors to structural steel using exothermic welds. Each particular type of weld shall use a kit unique to that type of weld.

B. TMGB and TGB Busbars
    1. Mount busbars using insulating standoffs. If not noted on drawings, install busbars onto wall at 24 inches AFF located within 5 feet of backbone pathways or rack bay.

C. Panelboard Bonding
    1. Where a panelboard is located in the same communications room as a TMGB/TGB and serves that room, provide TBC between busbar and that panelboard's Alternating Current Equipment Ground (ACEG) bus (where equipped) or the enclosure.

D. Bonding
    1. Provide TBC and appropriate grounding hardware between the nearest TMGB/TGB and the equipment racks / rack bay, overhead cable support, vertical cable support, telecommunication conduits, primary pathways that enter/exit the room (if applicable), and other metallic telecommunication infrastructure components.
    2. Minimum size: #6. If longer than 100 feet, size TBCs based on length using 1000 cmil per foot, up to 2/0 AWG.
    3. Install TBCs in a manner that will protect them from physical and mechanical damage.
    4. Routing:
        a. Route TBCs in the shortest possible path, using right angles for turns and routed parallel to building lines. Route on outside edges of wall plywood. Do not cut across the middle of the plywood taking space away from other equipment or components.
        b. Utilize a minimum 1-foot bend radius.
    5. Connection to TMGB/TGBs:
        a. Thoroughly clean busbars prior to attaching connectors to the busbar.

b. Fasten connectors (e.g., lugs) to the busbar using matching size cadmium bronze bolt, flat washer Belleville washer, and nut. Torque hardware set.

6. Rack Bay Bonding
   a. Provide bonding the rack bay.
   b. Bond equipment racks, frames, frame bays, cabinets, server racks, and other similar support systems located within the same room or space as the TMGB/TGB to the busbar.
   c. Use approved connectors for TBC-to-rack, -frame, and -cabinet connections.
   d. Rack bays may be bonded in series using either of the following configurations:
      1) Series: Provide a TBC from the TGB to the rack closest to the busbar; then provide a TBC to the other racks in the rack bay in series using a common lug/connection per rack. The rack shall not be used as a 'conductor' in the series connection.
      2) String: Provide one 'main' TBC from the TGB along the length of the rack bay, and provide a pigtail from the 'main' TBC per rack. Use an irreversible connection (such as "C" tap) for the 'main'-to-pigtail connection.
7. Overhead and Vertical Cable Support Bonding
   a. Bond overhead and vertical cable support located within the same room or space as the TMGB/TGB to the busbar.
   b. Provide either UL listed connectors and splice plates or UL Listed bonding strap to bond sections of overhead cable support for ground continuity. This requirement applies to cable tray, basketway, and runway sections within a single telecommunication room.
8. Termination Field Bonding
   a. Provide bonding the termination blocks.
   b. Bond termination blocks to the TMGB/TGB within the same room or space. Termination blocks may be bonded in series, with the block closest to the TMGB/TGB bonded to the busbar.
9. Metallic Raceway Bonding
   a. If TBC routes through conduit longer than 1 meter, bond metallic conduit to conductor at both ends.
   b. Bond metallic raceways for telecommunications cabling (conduit, cable tray, cable runway, and other metallic telecommunication infrastructure components) located within the same room or space as the TMGB or TGB to the nearest telecommunication grounding busbar.

3.04 LABELING

A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by the Engineer and Owner before installation.
2. Permanently label TBCs. Affix label as close as practical to each end of the conductor.

B. Label Format
1. Provide permanent labels with machine-generated text; hand written labels will not be accepted.
2. Labels on TBCs shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

C. Identifier Assignment
1. Separate label fields of the identifier with a hyphen.
2. Assign identifiers according to current practice and as approved by the Engineer and Owner before installation.
3. BCT and TBB
   a. First field: "BCT" or "TBB" (the conductor type).
   b. Second field: a unique sequential number, for example, "01".
   c. Example: "TBB-01"
4. GE
   a. First field: "GE" (the conductor type).
   b. Second field: floor number, for example, "06".
   c. Third field: a unique sequential number, for example, "01".
   d. Example: "GE-06-01"
5. Ground Busbars
   a. First field: "TMGB" or "TGB" (the busbar type)
   b. Second field: the room's identity (TR identifier's suffix) where the busbar is installed; for example, "3A2.1".
   c. Example: "TGB-3A2.1"
6. TBC:
   a. First field: "TBC" (the bonding conductor type).
   b. Second field: The room identity where TBC exists; for example: "A1.1".
   c. Third field: A unique sequential number; for example: "01", "02", etc.
   d. Fourth field: describe the device, equipment, component, or raceway being bonded.
   e. Example: "TBC-A1.1-01 (RACK BAY)"

3.05 GROUNDING BACKBONE RESISTIVITY MEASUREMENT

A. Measure ground resistance from the furthest ground busbar to earth; record measurement. Provide additional grounding electrodes, bonding, and other elements as required to comply with resistance limits specified in this Section.

B. Submit computer-generated records of measured resistance values to the Engineer and Owner for approval and for inclusion into the Operation and Maintenance Manual.

3.06 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00. Punching the Work of this Section may be combined with punching the rooms.

B. Comply with system acceptance and certification requirements of Section 27 00 00.

END OF SECTION 27 0526

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SECTION 270528
COMMUNICATIONS BUILDING PATHWAYS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes pathway systems for low voltage cabling and wiring.

B. Related Sections

1. Comply with related Sections 27 00 00 and 26 05 00.
2. Section 26 05 26 Grounding and Bonding for Electrical Systems
3. Section26 05 33 Raceway and Boxes for Electrical Systems

1.02 REFERENCES

A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:

B. Federal Specifications (FS):

1. FS WW-C-563: Electrical Metallic Tubing
2. FS WW-C-566: Specification for Flexible Metal Conduit

C. American National Standards Institute, Inc. (ANSI):

1. ANSI C80.3: Electrical Metallic Tubing, Zinc Coated
2. ANSI/NEMA OS-1 Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports

D. Underwriters Laboratories, Inc. (UL):

1. UL 514B: Conduit, Tubing and Cable Fittings
2. UL 635: Insulating Bushings
3. UL 797: Electrical Metallic Tubing – Steel
4. UL 50: Enclosures for Electrical Equipment
5. UL 514A: Metallic Outlet Boxes

E. ASTM International:

1. ASTM A123 – Specifications for Zinc (Hot Galvanized) Coatings on Iron and Steel
2. ASTM A510 – Specifications for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
3. ASTM A525 – General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process
4. ASTM B633 – Specifications for Electrodeposited Coatings of Zinc on Iron and Steel
5. ASTM A653 – Specifications for Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process
6. ASTM A591 – Specifications for Electrodepositing Coatings of Zinc on steel wire or sheets

F. National Electrical Manufacturer Association (NEMA)

1. NEMA VE 1 – Cable Tray Systems

2. NEMA VE 2-2000 – Cable Tray Installation Guidelines

1.03 DEFINITIONS

A. Definitions as described in Section 27 00 00 shall apply to this section.

B. In addition to those Definitions of Section 27 00 00, the following list of terms as used in this specification defined as follows:

1. "Cable Hanger": A metal, most often steel, or fabric cable support device often shaped (section view) similar to the letter J. The device is available in different sizes supporting different quantities of cables, and is also available with different attachment hardware to be supported by different methods (e.g., wire support, beam flange clip, etc.).
2. "Flat Bar": Custom cable support product manufactured by CEAS, Inc.
3. "Ladder Cable Tray": A continuous, rigid, aluminum cable support and management system. Available in different sizes supporting different quantities of cables.
4. "Wire Basket Cable Tray": A continuous, rigid, welded steel wire mesh cable support and management system. Available in different sizes supporting different quantities of cables, and is also available with different attachment hardware to be supported by different methods.

1.04 SYSTEM DESCRIPTION

A. Base Bid Work

1. Provide 12" ladder rack in IT room above rack and along sides of walls to support all cabling entering room. Basket tray to be utilized down main corridors and J-hooks to be utilized branching into rooms. Utilize EMT when cabling down walls or cabling into inaccessible walls/ceilings.

B. The work under this section shall include the planning and coordination (and other trades) of telecommunications system pathways, the furnishing of necessary materials, and the labor & associated services required to install telecommunications pathways.

C. All pathways should be installed in accordance with the most recent ANSI/TIA, NEC and the BICSI TDMM specifications.

D. The Telecommunications Pathways consist of the following subsystems:

1. Cable Tray Systems
2. Cable Hangers
3. Electrical metallic tubing and fittings.
4. Miscellaneous conduit fittings and products.
5. Wall and ceiling outlet boxes.
6. Pull and junction boxes.

1.05 SUBMITTALS

A. Comply with Submittal procedural, quantity, and format requirements of Section

27 00 00.

B. Submittal Requirements at Start of Construction:
C. Product Data Submittal
D. Shop Drawings Submittal: Consisting of proposed changes to pathway route plans.
E. Submittal Requirements at Close Out:
F. As-Built Drawings – primarily of the Communications Building Pathways.
G. Substitutions
H. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 27 00 00.

1.06 QUALITY ASSURANCE

A. Comply with the quality assurance requirements of Section 27 00 00.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 27 0000.

1.08 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 5 years. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. B-Line
B. CEAS
C. STI
D. RANDL
E. FSR
F. Wiremold
G. Panduit
H. Chatsworth
I. Or equal.

2.02 CONDUIT – EMT TYPE

A. EMT conduit shall conform to ANSI C80.3 specifications and shall meet UL requirements.
B. EMT conduit shall be formed of cold rolled strip steel, electrical-resistance welded continuously along the longitudinal seam and hot dip galvanized after welding.
C. Manufacturers:
    1. Alflex Corp
    2. Allied Tube and Conduit Co

3. Anaconda
4. Appleton Electric Co
5. Occidental Coating Co. (OCAL)
6. OZ/Gedney
7. Spring City Electrical Manufacturing Co
8. Thomas & Betts Corp
9. Triangle PWC, Inc
10. Western Tube and Conduit Corp
11. Or equal

2.03 CONDUIT – COUPLERS

A. EMT
   1. Set screw type couplings: Electroplated, steel or cast malleable iron, UL Listed concrete tight. Use set screw type couplings with four setscrews each of conduit sizes over 2 inches. Setscrews shall be of case hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
   2. Raintight couplings: Electroplate steel or cast malleable iron; UL Listed raintight and concrete tight, using gland and ring compression type construction.

2.04 CONDUIT – STRAPS

A. One-Hole and Two-Hole Straps
   1. Application: Strap, used in conjunction ion with fasteners, to hold conduit in place.
   2. Material: steel, malleable iron, or high tensile strength plastic straps (for inside building use) with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.

B. Channel Straps
   1. Application: Strap, used in conjunction ion with channel and (as applicable) fasteners, to hold conduit in place.
   2. Material: steel, malleable iron, or high tensile strength plastic straps (for inside building use) with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.

2.05 CONDUIT – MISCELLANEAOUS FITTINGS AND PRODUCTS

A. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.

B. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.

C. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL Listed for wet or dry locations.
D. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514B. Manufacturer shall be OZ/Gedney Type DX, Steel City Type EDF or equal.
E. Fire rated penetration seals:
    1. UL building materials directory classified.
    2. Conduit penetrations in fire rated separation shall be sealed with a UL classified fill, void or cavity material.
    3. The fire rated sealant material shall be the product best suited for each type of penetration, and may be a caulk, putty, composite sheet or wrap/strip.
F. Standard products not herein specified:
    1. Provide listing of standard electrical conduit hardware and fittings not herein specified for approval prior to use or installation, i.e. locknuts, bushings, etc.
    2. Listing shall include manufacturers name, part numbers, and a written description of the item indicating type of material and construction.
    3. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.

2.06 CABLE HANGERS

A. Application: Suitable for indoor installation within ceiling space for the support of communications cables.
B. Manufacturer:
    1. CEAS Figure 200 Series Low Voltage Supports
    2. Or equal

2.07 FLAT BAR

A. Application: Suitable for indoor installation within ceiling space for the support of communications cables.
B. Manufacturer:
    1. CEAS Figure 224 Low Voltage Support
    2. Or equal (no known equal)

2.08 FIRE RATED PENETRATION ASSEMBLY

A. Penetration assemblies shall be UL Listed for the application.
B. Penetration assemblies shall meet or exceed the rating of the wall (or floor) being penetrated.
C. Manufacturer
   1. STI EZ-Path 44+ Series
   2. Or equal (no known equal)

2.09 FIRE RATED /SMOKE BARRIER PENETRATION ASSEMBLY

A. Penetration assemblies shall be UL Listed for the application.
B. Penetration assemblies shall meet or exceed the rating of the wall (or floor) being penetrated.
C. Manufacturer
   1. STI EZ-Path 44+ Series
   2. Or equal (no known equal)

2.10 OUTLET BOXES

A. Telecommunications outlet box shall be one-piece die formed or drawn steel, knockout type box of size and configuration indicated on the drawings.
B. Box size: 5-inch square by 2-7/8 inch deep shall be minimum
C. Listing: C ETL US
D. Manufacturer
   1. RANDL Industries
      a. TB-55057 Telecommunications Bracket Outlet Box
      b. TB-55017 Telecommunications Outlet Box
      c. TB-55058 Telecommunications Bracket Outlet Box
      d. TB-55018 Telecommunications Outlet Box
   2. Or equal

2.11 WIRE MESH CABLE TRAY

A. Cable tray shall consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray will have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers.
   1. Cable tray systems shall include, but are not limited to, straight sections, supports and accessories.
   2. Product: Cablofil CF (or ZF) Series Cable Tray as manufactured by Legrand.
   3. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
      a. Mesh: 2 by 4 inches (50 by 100 mm).

b. Straight Section Lengths: 118 inches (3,000 mm).
c. Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray strength; and to allow tray to remain lightweight.
d. Safe-T-Edge: Patented Safe-T-Edge technology on side wire to protect cable insulation and installers' hands.
e. Fittings: Wire mesh cable tray fittings shall be field-fabricated from straight tray sections, in accordance with manufacturer's instructions.
f. Tape: Painted wire mesh cable tray to include metallic conductive UL tape.

4. Wire-Basket Dimensions
   a. 4 inches x 12 inches (typical)
5. Routing: Contractor to field coordinate cable tray routing with other disciplines.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of conduit system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 APPLICATION

A. Wire basket cable tray: Shall be used concealed for interior low voltage cables run above suspended ceilings.
B. Ladder cable tray: Shall be used in telecom rooms for support of low voltage cables.
C. Electrical metallic tubing (EMT): Shall be used concealed for interior low voltage cables where run above non-accessible ceilings, in stud walls, furred spaces and crawl spaces.

3.03 INSTALLATION

A. Support pathway systems per manufacturer requirements or as required by structural calculations.
B. The Contractor shall provide written documentation outlining and cable or pathway that does not meet requirement in the form of an RFI.
C. Interface with Other Work:
   1. Verify route prior to installation.
   2. Coordinate the installation of the cable pathway system with other trades.
   3. Do not support from ductwork, piping, or other equipment hangers.
   4. Install pathways so that cables do not touch or rest on other any other systems.
D. Installation clearances:
   1. Install systems to maintain a minimum clearance of four (4) feet from any motor.
   2. Install systems a minimum of six inches from fluorescent light fixtures, or other EMI sources. Power cables in EMT are acceptable.
   3. Refer to drawings for side and top access clearance requirements to cable basket.
   4. Refer to drawings for installation heights and clearances between cable

basket and building structures.

E. Ladder and Wire Basket Cable Trays
   1. Install cable tray systems in accordance with manufacturer's instructions and recognized industry practices and ensure that the installed system complies with requirements of the NEC and applicable portions of NFPA 70B, NEMA VE-2 "Cable Tray Installation Guidelines" and NECA's "Standards of Installation" pertaining to general electrical installation practices. Install cable basket system using splice connectors, support components, and other accessories by the same manufacturer.
   2. Splice system sections using UL classified connector bolt, supplied by the same manufacturer. Splicing assemblies shall be the bolted type using serrated flange locknuts.
   3. Bends shall have a minimum of a 12" bend radius.
   4. Provide radius shields at each bend/corner of "T" type intersections and cross intersections.
   5. Provide blind ends where cable tray termination is exposed (i.e. not at a wall)
   6. Ground system per NEC 70 Article 250. Provide approved connection bolt to join system sections such that the spine of the system is considered a bonding jumper. Properly bond system to approved ground, as per NEC Article 250. Provide external grounding strap at expansion joints, sleeves, crossovers, and at other locations where system continuity is interrupted.
   7. Test support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.
   8. Provided Cable Dropout in all locations where the cable transitions out of the tray more than 6". This includes transitions from all cable trays to equipment racks or other pathways.

F. Cable Hangers and Flat Bars
   1. Install hangers in accordance with recognized industry practices, to ensure that the installed system complies with requirements of the NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
   2. Provide dedicated supports at stud locations with a maximum of forty-eight (48") separation.
   3. Suspend wire or rod using components appropriate for the structure – e.g., powder- actuated clip fastener for wire, beam flange clip or angled flange clip for either wire or rod, or an embedded anchor for the threaded rod. Do not share support (wire/rod) with other trades. Do not support the hanger on ceiling grid support wires. Do not support the hanger from ductwork, piping, or other equipment hangers.
   4. Install hangers six inches (6"), minimum, from light fixtures or other EMI

source. Install hangers between six inches (6”) and twelve inches (12”) above ceiling grid.

G. Conduit
   1. Locations of conduit runs shall be planned in advance of the installation and coordinated with ductwork, plumbing, ceiling and wall construction in the same areas and shall not unnecessarily cross other conduits or pipe, nor block access to mechanical or electrical equipment.
   2. Where practical, install conduits in groups in parallel vertical or horizontal runs and at elevations that avoid unnecessary offsets.
   3. All conduits shall be run parallel or at right angles to the centerlines of columns and beams.
   4. Conduits shall not be placed closer than 12 inches to a flue, parallel hot water, steam line or other heat producing source or three inches from such lines when crossing perpendicular to the runs.
   5. Exposed conduit installation shall not encroach into the ceiling height headroom of walkways or doorways. Where possible, install horizontal raceway runs above water and below steam piping.
   6. In long runs of conduit, provide sufficient pull boxes inside buildings to facilitate pulling wires and cables, with spacing not to exceed 150 feet. Support pull boxes from structure independent of conduit supports. These pull boxes are not indicated on the Drawings.
   7. Provide all reasonably inferred standard conduits fitting and products required to complete conduit installation to meet the intended application whether noted, indicated or specified in the Contract Documents or not.
   8. Install conduit in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
   9. Minimum Conduit Size: Unless otherwise noted herein or on Drawings, minimum conduit size shall be 1-1/4".
   10. Install conduits in complete runs before pulling in cables or wires.
   11. Install conduit free from dented, bruises or deformations. Remove and replace any damaged conduits with new undamaged material.
   12. Conduits shall be well protected and tightly covered during construction using metallic bushings and bushing "pennies" to seal open ends.
   13. Clean any conduit in which moisture or any foreign matter has collected before pulling in conductors. Paint all field-threaded joints to prevent corrosion.
   14. In all empty conduits or ducts, install a “True Tape” conduit measuring tape line to provide overall conduit length for determining length of cables/conductors for future use.
   15. Conduit systems shall be mechanically and electrically continuous throughout.
   16. Metallic conduit shall not be in contact with other dissimilar metal pipes (i.e. plumbing).

17. Make bends with standard conduit bending hand tool or machines. The use of any item not specifically designed for the bending of electrical conduit is strictly prohibited.
18. A run of conduit between terminations at wire pulling points shall not contain more than the equivalent of two quarter bends (180 degrees, total).

H. Outlet Boxes
1. Install device/outlet boxes in accordance with manufacturer's written instructions, as indicated on drawings, and as specified herein.
2. Install boxes at the locations and elevations indicated on the drawings. Adjustment as required by field conditions and as coordinated with electrical and other trades.
3. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
4. Provide cast metal boxes with gasketed cast metal cover plates where boxes are exposed in damp or wet locations or located in hazardous areas.
5. Use conduit outlet bodies to facilitate pulling of conductors or to make changes in conduit direction only. Do not make splices in conduit outlet bodies.
6. Supports
7. Support boxes independently of conduit system.
8. Support boxes, mounted above suspended acoustical tile ceilings, directly from the structure above.

I. Waterproofing:
1. At floor, exterior wall and roof conduit penetrations, completely seal clearances around the conduit and make watertight.
2. For roof penetrations, provide roof flashing, counter flashing and pitch-pockets.
3. Provide membrane clamps and cable sealing fittings for any conduit that horizontally penetrates the waterproof membrane.
4. Conduits entering the building within grade that horizontally penetrate a waterproof membrane shall fall away from and below the penetration on the exterior side a minimum of two times the conduit diameters.

3.04 TERMINATIONS AND JOINTS

A. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location.
B. Raceways shall be joined using specified couplings or transition couplings where dissimilar raceway systems are joined.
C. Conduits shall be securely fastened to cabinets, boxes and gutters using two locknuts and an insulating bushing or specified insulated connectors. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or

dampness, use insulating bushings to protect conductors.

D. Conduit terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
E. Raceway seal: Inject into wire filled raceways, a pre-formulated rigid 2 lbs. density polyurethane foam which expands a minimum 35 times its original bulk. Foam shall have the physical properties of water vapor transmission of 1.2 to 3.0 perms; water absorption less than 2% by volume, fungus and bacterial resistant. Foam shall permanent seal against water, moisture, insects and rodents. Install raceway sealing foam at the following points:
    1. Where conduits pass from warm locations to cold locations to prevent passage of water vapor (such as refrigerated spaces, constant temperature rooms, air- conditioned spaces, etc.).

3.05 SUPPORTS

A. Secure raceways and systems to building structures using approved fasteners, clamps and hangers spaced according to the NEC and as specified in structural drawings for the project.

3.06 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00.
B. Comply with system acceptance and certification requirements of Section 27 00 00.
C. Weatherford IT will not approve or accept any pathway installation that does not meet the installation requirements and codes listed in this document.

END OF SECTION 27 0528

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SECTION 27 0811
COMMUNICATIONS TWISTED PAIR TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Testing of Communications Twisted Pair Cabling for both Backbone and Horizontal Cabling subsystems.

B. Related Sections
   1. Comply with the Related Sections paragraph of Section 27 00 00.
   2. Section 27 13 13 - Communication Twisted Pair Cabling

1.02 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

1.03 DEFINITIONS

A. Refer to Definitions of Section 27 00 00, Section 27 13 13

B. In addition to those Definitions of Section 27 00 00, the following list of terms as used in this specification defined as follows:
   1. “CAT6A”: Shall mean Augmented Category 6 cabling, per ANSI/TIA-568-C.2
   2. “CAT5E”: Shall mean Enhanced Category 5 cabling, per ANSI/TIA-568-C.2
   3. “Channel”: Shall mean a testing configuration which includes the Permanent Link and the line cord (at the workstation), the equipment cord, and, if a full crossconnection is implemented, a patch cord and the crossconnect termination/connecting apparatus.
   4. “Connect”: Shall mean install all required patch cords, equipment cords, cross- connect wire, etc. to complete an electrical or optical circuit.
   5. “Cord”: Shall mean a length of cordage having connectors at each end. The term “Cord” is synonymous with the term “Jumper” and “Lead”.
   6. “Permanent Link”: Shall mean the ‘permanent’ portion of the Horizontal cabling to each outlet with the test cords de-embedded from the measurements; this includes cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.
   7. “System Cord”: Shall mean the cord used in the operating transmission circuit.
   8. “Test Cord”: Shall mean the cord certified for use in testing, as described in this section.

1.04 SYSTEM DESCRIPTION

A. Refer to Section 27 00 00, and Section 27 13 13for addition system description information.

B. Work Provided Under Other Sections
   1. Backbone twisted pair cabling
   2. Horizontal twisted pair cabling

C. Base Bid Work
   1. Testing of a completed communication infrastructure cabling system, which includes:

a. Submittals
b. Testing of the twisted pair cabling as follows:

Table 270811-1.1: Tests For UTP Cabling

Horizontal	CAT6A	Category 6A	Permanen	Per EIA-568-C.2, 6.3

c. Record Documents, including test results.

1.05 SUBMITTALS

A. Comply with the Submittal requirements of Section 27 00 00.
B. Submittal Requirements at Start Of Construction:
   1. Testing Procedures Submittal, describing step-by-step procedures used by the field technicians.
   2. Product Submittal, including cut sheets of testing equipment to be used (note all software/ firmware versions as applicable).
   3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.
C. Submittal Requirements at Closeout:
   1. Record Documents:
      a. Submit one hard copy of warranty certificate.
   2. Format – Soft Copy:
      a. "Burn" onto one CD-ROM test report files as native data format (for example, an *.FLW file from a Fluke tester); if not possible to submit in native format, then issue test results as an exported Microsoft Excel compatible format.
      b. Include onto CD-ROM 'Viewer' software necessary to view, sort, filter, and print individual and summary test results from test results native format.
      c. Clearly label the CD-ROM with the following information:
         1) Client Name
         2) Project Name and Address
         3) CD-ROM Name (e.g., "Test Reports for Horizontal Cabling System")
         4) Date of Submittal – date format: <month> <day>, <year> (e.g., "January 1, 2020")
         5) Contractor Name
      d. Include a Table Of Contents at the beginning that lists the contents
      e. Organize the test reports by Backbone Cabling / Horizontal Cabling, by building, by floor, and by IDF.
      f. Sort reports in ascending cable ID order
      g. Include tabbed separators for improved navigation through the manual

1.06 QUALITY ASSURANCE

A. Comply with the Quality Assurance requirements of Section 27 00 00.

B. Under no circumstances shall any cable's and/or conductor's test results be substituted for another's. If an instance of falsification is confirmed, the Contractor is liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

1.07 WARRANTY

A. Warrant the validity of the test results.

PART 2 - PRODUCTS

2.01 BACKBONE TWISTED PAIR CABLING TESTER

A. Areas of Test Measurement (minimum): Wire Map (continuity, opens, shorts, crossed pairs, split pairs): Siemen test unit, with 25-pair adapter, or equal.

2.02 CATEGORY 6A HORIZONTAL CABLE TESTER

A. Equipment shall meet TIA/EIA-568-C.2-10 testing requirements. Equipment shall meet TIA/EIA-568B.2 Addendum 1 requirements for Level III accuracy. Equipment shall meet ISO/IEC Class C, D, E, and F.

B. Test Standards (minimum): TIA Category 6A (per TIA/EIA-568C.2 Addendum 1); ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 1000Base-T, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5

C. Areas of Test Measurement (minimum): Wire Map; Length; Insertion Loss; Near End Crosstalk (NEXT) loss, at both master unit and remote unit; ; Power Sum NEXT (PSNEXT) loss, at both master unit and remote unit;; ; Return Loss (RL), at both master unit and remote unit; Propagation Delay and Delay Skew; Attenuation-to- Crosstalk Ratio (ACR), at both master unit and remote unit; Power Sum ACR (PSACR), at both master unit and remote unit; Characteristic Impedance; DC Loop Resistance; and calculations for Power Sum ANEXT (PSANEXT) and Power Sum AFEXT (PSANEXT) loss, and for Power Sum Alien Attenuation-To-Crosstalk Ratio Far-End (PSAACRF) loss

D. Equipment: Fluke Networks

1. Versiv series test kit (main unit, remote unit, CAT6A permanent link adapters, CAT6A channel adapters, accessories), loaded with the latest firmware version.

PART 3 - EXECUTION

3.01 SCHEDULING

A. Prepare a construction schedule based on the schedule developed in Section 271313 and Section. Prepare updated schedules when changes in the schedule occur.

3.02 FIELD QUALITY CONTROL

A. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.

B. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the Engineer's discretion, halt testing activity and clean testing equipment, test cords, and related apparatus.
C. Permanently record test results.

3.03 BACKBONE TWISTED PAIR CABLING TESTING REQUIREMENTS AND PROCEDURES

A. Precautions
   1. Adhere to the equipment manufacturer's instructions during all testing.
   2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
   3. Fully charge power sources before each day's testing activity
B. Testing Requirements
   1. Test backbone multipair cabling per "Base Bid Requirements" in Part 1 of this Section.
   2. The installation will be accepted when testing has indicated availability of 100% terminated pairs.
C. Testing Procedures
   1. Test continuity and wire map for all pairs.
   2. Test length for 2% of pairs of each cable. Pairs shall be from different 25-pair binder groups.
D. Record Documents:
   1. Cable and pair identifiers of the test reports shall match the identifiers as labeled in the field – i.e., use the same ID on the cable label/termination label as what appears on the test reports.
   2. Measurements shall carry a precision through no significant decimal place.
   3. Each test report shall contain the following information (not necessarily in this order):
      a. Project name
      b. Cable identifier, pair number(s)
      c. Date measurement were obtained
      d. Operator (company and name)
      e. Test equipment model and serial number(s)
      f. Measurement results

3.04 HORIZONTAL CATEGORY 6A TESTING PROCEDURES

A. Precautions
   1. Adhere to the equipment manufacturer's instructions during all testing.
   2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
   3. Fully charge power sources before each day's testing activity

B. Test Equipment Set Up
   1. Set up the tester to perform a full CAT6A test, as a Permanent Link configuration.
   2. If the tester has the capability, set the cable type as product-specific setting. If not, set as generic CAT6A.
   3. Set the tester to save the full test results (all test points, graphs, etc.).
   4. Save the test results with the associated cable link identifier.
   5. Calibrate the test set per the manufacturer's instructions.

C. Acceptable Test Result Measurements
   1. Overall Test Results:
      a. The Owner shall accept only individual test results that result in a Pass.
      b. Links which report a Fail, Fail* or Pass* for any of the individual tests shall result in an overall link Fail.
      c. Any reconfiguration of link components required as a result of a test Fail, must be re- tested for conformance.
      d. Remove and replace any cabling links failing to meet the criteria described in this specification, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.
   2. Wire Map: Correctly terminate all pairs of the cabling link at both ends. Provide only continuous pairs. No exceptions.
   3. Length: Ninety-four meters is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.
   4. Insertion Loss: The acceptable insertion loss measurements for any CAT6A cabling link is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.
   5. Worst Pair-to-Pair Near End CrossTalk (NEXT) Loss: The acceptable worst pair- to-pair NEXT loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.
   6. Power Sum NEXT Loss: The acceptable power sum PS-NEXT loss for any CAT6A cable is that which is no greater than that as listed in ANSI/EIA-568-C.2, 6.3.
   7. Worst Pair-to-Pair ELFEXT and FEXT Loss: The acceptable worst pair-to-pair ELFEXT and loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.
   8. Return Loss: The acceptable return loss measurements for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.
   9. Propagation Delay and Delay Skew: The acceptable propagation delay and delay skew measurements for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

D. Records
   1. Permanently record test results.
   2. Export all of the numerical test results to a single spreadsheet in Microsoft Excel® (*.xls) or (*.xlsx) file format.

3. Submit test results at the conclusion of the testing to the Engineer for approval. Engineer will check these test reports for a format acceptable to the Owner, or Owner's Representative.
4. For each Horizontal CAT6A test, record the following information:
    a. Project name and address
    b. Testing Company's and Operator's name
    c. Date of measurement
    d. Test equipment, including the following:
        1) Manufacturer, model, and serial number
        2) Date and time of last calibration
    e. Identification number of cable
    f. Overall test result

END OF SECTION 27 0811

SECTION 27 0821
COMMUNICATIONS FIBER OPTIC TESTING

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes: Testing of communications fiber optic cabling.

B. Related Sections

1. Comply with the Related Sections paragraph of Section 27 00 00.
    a. Section 27 13 23 - Communication Backbone Fiber Optic Cabling

1.01 REFERENCES
A. Comply with the References requirements of Section 27 00 00.

B. In addition, the following standards are referenced to this Section, including all standards referenced in these documents:

1. TIA/EIA-526-14A (OFSTP-14) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
2. TIA/EIA-526-7 (OFSTP-7) “Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant”
3. BICSI Telecommunication Distribution Methods Manual

1.02 DEFINITIONS
A. Refer to Definitions of Section 27 00 00 and Section 27 13 23.

B. In addition to those Definitions of Section 27 00 00, the following list of terms as used in this specification defined as follows:

1. “Adapter” (associated with fiber connectivity): Shall mean a connecting device that joins 2 fiber connectors, either like or unlike
2. “Connect”: Shall mean install all required test cords, patch cords, system cords, etc. to complete an optical circuit
3. “CPR”: Coupled Power Ratio (according to TIA/EIA-526-14A Annex A
4. “Cord”: Shall mean a length of cordage having connectors at each end; the term “Cord” is synonymous with the term “Jumper”
5. “Jumper”: See “Cord”
6. “Passive Link Segment”: Shall mean the cable, connectors, couplings, and splices between two fiber optic termination units
7. “System Cord”: Shall mean the cord used in the operating electrical or optical circuit.
8. “Test Cord”: Shall mean the cord certified for use in testing, as described in this section

1.03 SYSTEM DESCRIPTION
A. Refer to Section 27 00 00 and Section 27 13 23 for addition system description information.

B. Work Provided Under Other Sections

1. Backbone fiber optic cabling
2. Base Bid Work
3. Submittals: pre-testing and post-testing
4. Testing of completed fiber optic passive link segment(s) per the following table:

Table 270821-1.1: Tests For Fiber Optic Cabling

Subsystem	Type	Test	Direction	Wavelength
Backbone	Multimode	Optical Power Loss	Both	850nm and 1300nm
Backbone	Singlemode	Optical Power Loss	Both	1310nm and 1550nm

5. Record Documents, including test results

1.04 SUBMITTALS

A. Comply with the Submittal requirements of Section 27 00 00.
   1. Submittal Requirements at Start of Construction:
   2. Testing Procedures Submittal: Describe step-by-step procedures used by the field technicians.
   3. Pre-Testing Loss Calculations Submittal: Calculate the loss of each segment. The cable length may be based on the footage markings printed on the cable jacket. Include a brief description of each segment.

B. Product Submittal, including cut sheets of testing equipment and the following information (*this data must match the test reports*):
   1. Manufacturer and model number
   2. Serial number
   3. Date of last factory calibration
   4. Software/ firmware versions (as applicable)

C. Schedule Submittal, consisting of proposed schedule of work (this schedule may be combined with the schedule developed for Division 27)

D. Submittal Requirements at Closeout:

E. Submit test results and reports in a format acceptable to the Owner, or Owner's Representative, or Engineer before system acceptance.

F. Submit one soft copy of test reports, including all tested parameters. This may be combined with the reports of Section 270811.

G. Submit one hard copy of warranty certificate from the manufacturer and the Contractor

H. Each test report (per strand per cable link) shall include the following information:
   1. Project/Client name, and project address
   2. Date of test
   3. Contractor (Company) and Technician's name
   4. Test equipment, including Serial Numbers (*must match pre-testing submittal*)
   5. Test procedure (e.g., OFSTP-14A) and method (e.g., Method B)
   6. Light source's launch category (including CPR) and spectral width
   7. Wavelength

8. Cable identifier, fiber number, and fiber type (e.g., “multimode”)
9. Measurement direction, including end locations
10. Optical loss measurement

I. Cable and fiber identifiers of the test reports shall match the identifiers as labeled in the field –i.e., the ID stored with the test result shall be the same ID as on the cable label/fiber port label.

J. Format – Soft Copy:
1. “Burn” onto one CD-ROM test report files as native data format (for example, an *.FLW file from a Fluke tester).
2. Include onto CD-ROM (or separate CD-ROM) ‘Viewer’ software necessary to view, sort, filter, and print individual and summary test results from test results native format.
3. Clearly label the CD-ROM with the following information:
   a. Owner Name
   b. Project Name and Address
   c. CD-ROM Name (e.g., “Test Reports for Backbone Cabling System”)
   d. Date of Submittal – date format: <month> <day>, <year> (e.g., “January 1, 2020”)
   e. Contractor Name

1.05 QUALITY ASSURANCE

A. Comply with the Quality Assurance requirements of Section 27 00 00.

B. Testing equipment shall be fully functional and in proper working order. Testing equipment shall be factory calibrated within the manufacturer’s published calibration period. Testing equipment must have loaded the latest firmware / operating software.

C. Under no circumstances shall any cable’s and/or conductor’s test results be substituted for another’s. If an instance of falsification is confirmed, the Contractor will be liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

1.06 WARRANTY

A. Warrant the validity of the test results. Issue such warranty in writing.

PART 2 - EXECUTION

2.01 FIELD QUALITY CONTROL

A. Prior to the start of testing, set up a meeting with the Engineer to witness testing procedures. The Engineer will, at their discretion, come to the site and witness the technician’s actual testing procedures. The Engineer may give verbal comments to correct the technician’s procedures to meet these requirements, followed up with a written observation report.

B. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day’s testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.

C. Use undamaged test equipment and test cords. Clean connectors and adapters (with a lint-free wipe and 90% (or higher) isopropyl alcohol) prior to and during testing activities. Per the Engineer’s discretion, halt testing activity and clean testing equipment, test cords, and related apparatus.

D. Permanently record test results.

2.02 OPTICAL POWER LOSS TESTING REQUIREMENTS AND PROCEDURES

A. Safety: Use test equipment containing a laser or LED in accordance with ANSI Z136.2

B. Test fiber optic passive links per "Base Bid Work" under System Description in Part 1 of this Section. Follow the procedures in the following order.

C. Precautions

1. Adhere to the precautions described in TIA-526-14A, 5.1.
2. Adhere to the equipment manufacturer's instructions during all testing.
3. Prior to any testing activity or any measurements taken:
   a. Ensure test equipment is at room temperature – approximately 72 degrees F (if necessary, bring the test equipment in from outdoors and let it set until the test equipment reaches room temp).
   b. Power on the light source and power meter for at least 5 minutes prior to obtaining measurements.
   c. Clean connectors and adapters with a lint-free wipe and 90% (or higher) isopropyl alcohol.
4. Do not power off the light source or the power meter during testing activity.
5. Do not remove Test Cord #1 from the light source at any time (unless the testing is complete or the equipment is being put away for the evening).
6. Do not bend the test cords smaller than 20 times the cord diameter (this may induce loss into the cord reducing the accuracy of the measurement).

D. Test Cord Performance Verification

1. Connect Test Cord #1 to the light source and to the power meter.
2. Set this value into the power meter as the reference power (Pref).
3. Disconnect Test Cord #1 from the power meter. Do not disconnect Test Cord #1 from the light source.
4. Connect the 'open' end of Test Cord #1 to an adapter (of matching connector type). Connect one end of Test Cord #2 to that adapter and the other end of Test Cord #2 to the power meter.
5. The value displayed on the power meter represents the test cord #2 connection loss.
6. Flip the ends of Test Cord #2 so that the end connected to the power meter is now connected to the adapter (attached to test cord #1), and the end connected to the adapter is now connected to the power meter.
7. The value displayed on the power meter represents the test cord #2 connection loss on the opposite end.
8. Both connection loss measurements must be less than or equal to 0.20 dB for multimode and 0.30 dB for singlemode.
9. Repeat this test procedure from the beginning reversing the test cords in order to verify the performance of test cord #1.

E. Test Equipment Set Up

1. Follow the test equipment manufacturer's initial adjustment and set up instructions.

2. Set the power meter to Relative Power Measurement Mode
3. Set the meter to display power levels in dBm.
4. Set the light source and power meter to the same wavelength.

F. Multimode Passive Link Insertion Loss Testing Procedures
1. Only use a light source that exhibits a Category 1 modal launch condition. Confirm the light source's modal launch condition following the procedures described in TIA-526-14A, Annex A.
2. Test Method: For 'permanent' links, perform the optical power loss testing of multimode fibers according to TIA-526-14A, 5.3 "Method B: One Jumper Reference".

G. Singlemode Passive Link Insertion Loss Testing Procedures
1. Determine Launch Conditions:
   a. Use the launch conditions, as described in FOTP-78.
2. Test Method: Perform the optical loss testing of singlemode fibers according to "Test Method A.1: One Jumper Measurement", per OFSTP-7.

H. Acceptable Measurement Values
1. The measured loss shall not exceed the calculated loss of the pre-testing submittals.

I. Record Test Measurements:
1. Permanently record all test data per strand, including the following (minimum);
   a. Project name
   b. Cable identifier, fiber number, and fiber type (e.g., "multimode")
   c. Testing company name
   d. Testing technician's name
   e. Date measurements were obtained
   f. Measurement direction
   g. Wavelength
   h. Loss measurement
   i. Test equipment model and serial number(s)
2. Measurements shall carry a precision through one significant decimal place, minimum.

END OF SECTION 27 0821

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SECTION 27 1100
COMMUNICATIONS EQUIPMENT ROOM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Buildout of communications equipment rooms.

B. Related Divisions and Sections

1. Comply with the Related Sections paragraph of Section 27 00 00.
2. Drawings, general provisions of the Agreement, and Division 01 apply to this Section.
3. Consult other Divisions, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
4. Comply with cable tray installation in Section 27 05 28

C. Unit Pricing:

1. Unit prices shall include material, labor, shipping, tax, markups (overhead, profit, job expenses, bonding), labeling, records, and as-built drawings.

1.02 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

B. In additional to those codes, standards, etc., list in Section 27 00 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI/EIA-310-D-1992, “Racks, Panels And Associated Equipment”

1.03 DEFINITIONS

A. Definitions as described in Section 27 00 00 shall apply to this section.

1.04 SYSTEM DESCRIPTION

A. General: Communications rooms shall fall into one of the following space titles:

1. Telecommunications Room/TR/DATA

B. Room Functions:

1. Entrance Facility (EF) will serve the following functions:
   a. Act as minimum point of entry (MPOE) for telecommunications utility (e.g., AT&T)
   b. House telecom utility’s termination field(s) and interface between telecom utility’s facilities and premises facilities
   c. Main entrance point for all communications conduit entering the building
   d. Houses network equipment (i.e. core switch/router, processing eqmt/servers) and voice system equipment (i.e. VoIP system)
   e. House interbuilding and intrabuilding twisted pair and fiber optic backbone cabling and main crossconnect field

f. Houses network equipment (i.e. access switches) serving the horizontal cabling
g. Houses horizontal termination field – for voice/data/CATV – outlets served from this room (refer to floor plans for area served)
h. House voice backbone crossconnect field and data backbone crossconnect field (if required)
i. House horizontal termination field – both voice and data – of outlets served from this room (refer to drawings for area served).
j. House network equipment (i.e. access switch) serving users of the room's service area

C. Work Covered Under Other Sections
1. Plywood backboards
2. Bonding
3. Grounding busbars
4. Power and cooling
5. Conduit, device boxes, and sleeves

D. Base Bid Work
1. The Work under this section includes materials, accessories, fasteners, etc., and the labor and associated services required for the buildout / fit-up of telecommunications equipment rooms, and includes coordination through the General Contractor with other trades
2. In general, the Work includes the following:
a. Submittals
b. Rack bays (equipment racks, vertical management sections, anchoring)
c. Cable, wire and patch cord management
d. Overhead cable support
e. Racks and Cabinets
f. Identification tags and labeling
g. Record Documents
h. Warranty

E. Coordination Requirements
1. Electrical: Coordinate layout with electrical contractor to ensure proper placement of lighting, sequencing of power service to rack bay, and other issues related to electrical trade.
2. Owner: Coordinate room-ready requirements and schedule with Owner (to allow Owner to plan and execute installation of telecommunications/network equipment).

1.05 SUBMITTALS

A. Comply with the Submittal requirements of Section 27 00 00.
B. Quantity: Furnish quantities of each submittal as noted in Section 27 00 00.
C. Submittal Requirements at Start of Construction:
1. Product Data Submittal

2. Shop Drawings Submittal: Consisting of any proposed changes to room plans.
3. Sample Submittal: Submit sample of equipment rack label
4. Schedule Submittal: Submit proposed schedule of work (this schedule may be combined with the schedule developed for Division 27.

D. Submittal Requirements at Close Out:
1. As-Built Drawings Submittal

E. Substitutions
1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 27 00 00.

1.06 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.08 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 1 year. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.02 EQUIPMENT CABINET

A. General
1. Contractor must drill cabinet into floor.
2. Chatsworth ZB22-ASS100-71 w/ keyed lock
   a. Or equal

2.03 CABLE RUNWAY

A. Cable Runway Straight Sections
1. Application: Suitable for the support & management of telecommunications (and other low voltage) cables, either overhead or mounted vertically on a wall, within Telecommunications Room. Also overhead equipment rack bracing.
2. Construction: Constructed of two longitudinal side elements – “stringer”, with elements periodically crossing between stringers – “rung”; Rungs spaced 12” on center, and welded to stringer.
3. Material (both stringer and rung): Steel tube, rectangular, 1-1/2” by 3/8” by 0.65” wall thickness.
4. Size: Sized to provide 60% free capacity after all install.
5. Manufacturers:
   a. CPI
      1) 12”W cable runway, black

b. Or equal

B. Cable Runway Sweep Fittings
1. Application: Suitable for the support & management of telecommunications cables, overhead.
2. Material (both stringer and rung): Steel tube, rectangular, 1-1/2" by 3/8" by 0.65" wall thickness.
3. Manufacturer:
a. CPI
1) Horizontal sweep fitting for 18" wide cable runway, black
b. Or equal

C. Cable Runway Installation Accessories
1. Application: Installation accessories for use with cable runway.
2. Manufacturer:
a. CPI
1) Or equal

2.04 LABEL PLATES, FOR EQUIPMENT RACKS

A. Label plate shall be suitable to affix onto top angle of equipment rack or onto the top front of a frame/cabinet.
B. Label plate shall be 'engrave-able' stock melamine plastic laminate substrate.
C. Size (minimum): 4-inch high by 6 inches long by 1/16-inch thick
D. Color: black
E. Lettering shall be white, engraved, 2-inch high

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with the Execution requirements of Section 27 00 00.

3.02 EXAMINATION AND PREPARATION

A. Prior to installation, verify equipment rooms are suitable for the construction scope of this section. Schedule work to prevent damage caused by other trades during the course of that other construction.
B. Prepare surfaces, such as floors, for permanent installation of products, such as racks.

3.03 INSTALLATION

A. Rack/Cabinet Bays
1. Provide 7-foot high rack bays in telecommunications room per drawings.
2. Equipment Racks and Cabinets
a. Provide parts and accessories required to complete each rack. Completely assemble racks, according to manufacturer's instructions.
b. Anchoring/Bracing

1) Anchor racks to the structural floor at four points.
2) Brace racks overhead to overhead cable support.

3. Vertical Management Sections
   a. Provide vertical management sections.
   b. Bolt vertical management sections to the equipment racks at the points designed by the manufacturer and per the manufacturer's installation instructions.
4. Tolerances:
   a. Equipment Rack: Verify dimensions to establish proper clearances as follows:
      1) Front: 40" clearance from channel's front mounting flange.
      2) Back: 57" clearance from channel's back mounting flange.
   b. Provide the correct amount of space between each rack for proper installation (according to manufacturer's written instructions) of the vertical management sections.
5. Horizontal Management Panels
   a. Provide horizontal management panels. If not shown, provide one management panel above each patch panel and on below the bottom patch panel in each rack bay where patch panels occur.
   b. Provide fasteners and parts required to complete the installation.
6. Accessories
   a. Furnish rack mounting screws – Turn over 1 bag of screws per Telecom Room, to the owner at the end of the project.

B. Overhead Cable Support
   1. Provide support devices (e.g., brackets and threaded rod with strut) for overhead cable management system; install per the manufacturer's instructions and fastened to the wall or ceiling using appropriate fasteners.
   2. Provide parts required for complete installation (e.g., mounting brackets, splice kits, hardware, etc.).
   3. Tolerances
      a. Install overhead cable support centered over the equipment rack, or as shown on the Drawings.
   4. Interface with Other Work: Coordinate the installation of the overhead cable support with other trades. Trapeze supports and 'hanger rods' ("all-thread"), for example, may be shared to lower overall construction cost.
   5. Provide waterfall transitions above each rack vertical wire manager.
   6. Provide cable retaining post every 18" along cable runway pathways.
   7. Provide cable drop outs at any point cables transition to or from the cable pathway.

C. Vertical Cable Support
   1. Provide cable runway installed vertically for use to support cables routing vertically within telecommunications rooms.

2. Provide parts required for complete installation (e.g., vertical mounting brackets, bolts, etc.).
3. Install the cable runway such that the rungs are facing outward (the greater distance from the rung to the stringer edge is facing inward

3.04 LABELING

A. General Requirements: Labeling and identifier assignment shall conform to TIA/EIA- 606-A Administration Standard and as approved by Owner before installation.

B. Equipment Rack Label Requirements: Provide one label plate per rack and cabinet/frame. Permanently affix label plate and position as shown on the Drawings; if not shown on the Drawings, center the label plate on the rack's front top angle or the cabinet's top front frame.

C. Identifier Assignment
   1. Equipment Racks
      a. Prefix: "RACK"
      b. First field: the TR room identity; for example: "02.S".
      c. Second field: the rack number; for example: "01".
      d. Example; "RACK 02.S-01"

3.05 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 0000.

B. Comply with system acceptance and certification requirements of Section 27 0000.

END OF SECTION 27 1100

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SECTION 27 1313
COMMUNICATIONS TWISTED PAIR CABLING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Backbone and horizontal twisted pair cabling

B. All cabling in project to be CAT6A for WAPS, CAT6 all other devices.

C. Related Sections
   1. Comply with the Related Sections requirements of Section 27 00 00
   2. 27 08 11 Communication Twisted Pair Testing

1.02 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for Definitions.

B. In addition, define the following list of terms as used in this specification as follows:
   1. “ALVYN”: sheath type consisting of corrugated polymer-coated aluminum shield with and adhered flame retardant jacket
   2. “ARMM”: Bell system cable type (shielded riser)
   3. “CAT3”: Category 3 [UTP] performance grade
   4. “CAT5E”: Category 5 Enhanced [UTP] performance grade
   5. “CAT6”: Category 6 [UTP] performance grade
   6. “CAT6A”: Category 6 Augmented [UTP] performance grade
   7. “Channel”: End to end transmission path; e.g., the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.
   8. “CMP”: Communications Media Plenum [NEC plenum rating]
   9. “CMR”: Communications Media Riser [NEC riser {non-plenum} rating]
   10. “FEP”: Fluorinated Ethylene Propylene
   11. “FTP”: Foiled Twisted Pair
   12. “ISP: - Inside Plant Cabling
   13. “OSP” Outside Plant Cabling
   14. “PE”: Polyethylene
   15. “Permanent Link”: Test configuration for a horizontal cabling link excluding patch cords, equipment cords, and line cords; e.g., the ‘permanent’ portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in the TRs and the connector at the outlet.
   16. “PIC” Plastic Insulated Conductor
   17. “PVC”: PolyVinyl Chloride

18. "PVDF": Polyvinylidene fluoride
19. "UTP": Unshielded Twisted Pair

1.04 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections
   1. Pathways: The communications pathways (cable tray, conduits, stubs, etc.) work will be covered under another Section. Refer to the Drawings for size/capacity and route information.
   2. Rooms: Build out (e.g., backboards, overhead and vertical cable runway, etc.) of the telecommunications rooms will be covered under another Section. Refer to the Drawings for build out information.

B. Base Bid Work
   1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working communications Backbone and Horizontal Twisted Pair Cabling System installation described in this Section and shown on related Drawings. Consider Backbone and Horizontal Cabling as shown on Drawings as base bid work, unless otherwise noted. This includes terminations at both ends.
   2. In general, the base bid work includes:
      a. Submittals
      b. Backbone and Horizontal cables, terminations, and outlets
      c. Cable management
      d. Patch cords and crossconnections
      e. Cable identification tags and system labeling
      f. Record Documents
      g. Warranty
   3. City Coordination Instructions:
      a. Contractor to terminate at patch panel and at the wall plates (data and coax).
      b. Keystone into patch panel.
      c. Wiring: Modular connectors shall be T568B wired.
      d. A three-foot (3') service loop secured above ceiling prior to the end device location.
      e. Cable Colors: Blue Only

1.05 SUBMITTALS

A. Comply with the Submittals article of Section 27 00 00 for procedural, quantity, content, and format requirements.

B. Substitutions
   1. Conform to substitutions requirements and procedure in Section 27 00 00.

C. Submittal Requirements at Start of Construction:
   1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
   2. Sample Submittal, consisting of the following components:

a. Type “A” Outlet Sample – one fully configured outlet including faceplate, modular jacks, and label
b. Cable Label Sample

3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 27xxxx series Sections
4. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations

D. Submittal Requirements at Closeout:
1. As-Built Drawings
2. Cable ID –to– Office Number Key: Submit a “cable ID-to-Office number key” as an electronic file in an MS-Excel spreadsheet file format containing a list of every cable identifier associated with the final office number
3. Crossconnection records/cut sheets
4. O & M Manuals per section 27 00 00

E. Posted Documentation
1. Post one full size plot of as-built drawings, specifically the floor plans and (as applicable) reflected ceiling plans, within TR’s such that show the TR’s serving area. Coordinate location with Owner.

1.06 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 27 00 00.

B. Contractor Qualifications
1. In addition to the Contractor Qualifications requirements of Section 27 00 00, the Contractor shall be certified by the manufacturer to provide the cabling system (proposed, submitted, and approved) and to provide an extended warranty. Submit satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Delivery, Storage and Handling requirements of Section 270000.

1.08 WARRANTY

A. The horizontal cabling system, as specified in this section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover electrical performance of cabling system to the specific category per ANSI/TIA/EIA-568-C performance criteria for horizontal cabling.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

1. Panduit (Basis for design)

2. CommScope
3. Belden

2.02 SUBSTITUTIONS

A. Comply with the Substitutions requirements of Section 270000.

2.03 HORIZONTAL CABLE – CAT6 Minimum Compliant, CAT6 and CAT6A UTP, PLENUM (CMP) RATED (FOR USE THROUGHOUT)

A. Application: Suitable for indoor installation, within ceiling space in primary and secondary pathways, within access/raised floor space.

B. Conductors:
1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or equivalent).
2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S- 80-576-1994, and EIA-230).

C. Cable Sheath:
1. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
2. Flame Rating: NEC (Article 800) rated as CMP, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-C.2, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.

E. Color: See color table in Part 3 for cable colors

a. Manufacturer:
1) Panduit
a) #PUP6XHD04BU
b) Or equal

2.04 MODULAR PATCH CORDS – CAT6 and CAT6A 10 GIG RATED

A. Application: Suitable for indoor installation within a telecommunications room or workstation environment.

B. Cords assembled from a single, continuous length of cordage, homogenous in nature, and terminated at both ends via 8 position modular plugs. Splices are not permitted anywhere.

C. Cordage
1. Insulated Conductors: 24AWG solid copper, fully insulated with a flame retardant thermoplastic material (such as PVC, or equivalent).

2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair), and individually color coded.
3. Unshielded sheath and flame-retardant polyvinyl chloride (PVC) jacketed.
4. Flame Rating: NEC CM (or higher) rated, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-C.2, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.

E. Length: Refer to Outlet Schedule for length requirements.

F. Color: Blue

G. Manufacturer:

1. Patch cable to match cable type listed in 2.03

H. Cable Counts:
1. Provide 1’ patch cable for switch side
2. Provide 7’ patch cable at workstation side
3. Provide 25% additional (above # of cables installed) patch

2.05 CROSSCONNECT WIRE

A. Crossconnect wire shall be suitable for installation within a telecommunication facility and fully compatible with the termination apparatus specified within this Section.

B. Crossconnect wire shall be manufactured from a single, continuous length of insulated wire, homogenous in nature. Splices are not permitted anywhere. Factory splices of insulated conductors are expressly prohibited.

C. Conductors:
1. Insulated Conductors: 24 AWG conductors of solid copper. Fully insulated conductors with a flame retardant thermoplastic material (such as PVC, or equivalent).
2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair), individually color-coded.

D. Manufacturer:
1. General Cable
   a. # 7023864; crossconnect wire, 1 pair, Whi-Red / Red-Whi
   b. # 7023708; crossconnect wire, 1 pair, Whi-Blu / Blu-Whi
2. Or equal

2.06 BEP PROTECTOR – FOR DATA CIRCUITS

A. Application: Protectors suitable for installation within a telecommunication facility for the termination of the Horizontal OSP/Underground cables intended for data circuits.

B. Protector shall be UL 497 listed.

C. Solid-state protection with clamping voltage of 16VDC

D. Protector shall have a 4-pair capacity (minimum) with 110-type input and 110-type output

E. Manufacturer:
   1. CommScope SYSTIMAX
      a. #760028373; OSP protector, CAT6 rated, 2-cable capacity
      b. #760033951; OSP protector, CAT6 rated, for PoE circuits, 2-cable capacity
   2. Or equal

2.07 MODULAR CONNECTOR / 8-POSITION JACK – CAT6 Net-Key, CAT6 and CAT6A 10GIG RATED

A. Application: Modular connectors shall be 8-position modular jacks and shall be compatible with the specified CAT6 and CAT6A UTP 4-pair cables both electrically and physically.

B. Mechanical Performance: Modular connectors shall meet or exceed TIA/EIA-568-C.2 5.7.
   1 Electrical Performance: Modular connectors shall meet or exceed TIA/EIA-568-C.2 6.8 and ISO/IEC 11801 requirements for CAT6A UTP cabling.
   2 Wiring: Modular connectors shall be T568B wired.
   3 Manufacturer:
   A. Panduit
   1. Cat6A Netkey
   2. Or Equal

2.08 WORK AREA OUTLETS

A. Faceplates for Standard Flush-Mount Outlets
   1. Application: Faceplates shall be suitable for indoor installation for standard 1-gang and 2-gang flush-mount devices.
   2. Faceplates shall have 2, 3, 4, or 6 ports, and shall include required accessories, such as icons, blank inserts, label windows and labels.
   3. Color: White
   4. Manufacturer:
      a Panduit Netkey Series
      b Or Equal

B. Surface Outlets
   1. Application: Surface outlets shall be suitable for indoor installation for surface-mount device and shall be fully compatible with the specified modular connectors/jacks.
   2. Color: White
   3. Manufacturer:
      a Panduit Netkey Series (Utilize surface mount for WAP's)
      b Or Equal

2.09 CABLE LABELS

A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.

B. Label shall fully wrap around the cable's jacket, shall be adhesive-backed labels, and shall have a self-laminating feature.

C. Size: 1" x 0.5" printable area, minimum

D. Color: white

E. Manufacturer:
   a. Panduit
      1) #S100X150YAJ; cable labels, 1.0" x 1.5", for cable diameters 0.16"-0.32", white
      2) #S200X225YAJ; cable labels, 2" x 2.25", for cable diameters 0.24"-0.48", white
      3) #S200X400YAJ; cable labels, 2" x 4", for cable diameters 0.32"-0.95", white
   b. Or equal

2.010 MISCELLANEOUS COMPONENTS

A. Velcro Cable Ties
   1. Width: .75".
   2. Color: Velcro cable ties the same color as the cable to which it is being applied.
   3. Manufacturers:
      a. Panduit "Tak-Ty" series cable ties
      b. Panduit #HLS-15R-0; black, 15' roll, cut to length.
      c.Or Equal

B. Plenum Cable Ties
   1. Application: for use in plenum or air handling spaces
   2. Color: maroon or other distinctive non-white color
   3. Manufacturer
      a. Panduit
         1) #PLT1M-xxxx
         2) #PLT2S-xxxx
         3) #PLT3S-xxxx
      b. Or equal.

2.011 OSP DUCT PLUGS

A. Multi-Port Duct plugs
   1. Manufacturer
      a. Tyco
         1) #40B167S; 4-inch triplex plug
         2) #40Q136S; 4-inch quadplex plug

b. Carlon
c. Condux
d. Or equal

B. Port/Cable plugs, for securing one cable per duct plug port.
1. Manufacturer:
a. Tyco
1) #10S035S; simplex plug for one fiber optic cable in 1-inch ID port
2) #11S057SB; simplex plug for one fiber optic cable fiber in 1¼-inch ID port
3) #10D104U; blank port plug for 1-inch ID port
4) #12D148U; blank plug for 1¼-inch ID port
b. Carlon
c. Or equal

C. Blank Duct Plug for 4" Conduit
1. Manufacturer
a. Tyco # JM-BLA-40D402U; blank duct plug for 4" conduits
b. Carlon
c. Or equal

2.012 TERMINATION APPARATUS – MODULAR FACEPLATE PATCH PANELS

A. Modular patch panels shall be suitable for installation within a telecommunication room for the termination of the Horizontal Cables specified herein. Modular patch panels shall be horizontally oriented for a rack-mounted configuration. Modular patch panels shall be capable of supporting, organizing, labeling and patching/ crossconnecting between the horizontal termination field and the equipment termination field. Modular patch panels shall be supplied with an integrated strain relief bar in the rear of the panel for cable management.

B. 48-port angled patch panel with labels, supplied with twelve factory installed CFFPL4 type front removable snap-in faceplates, populated with category 6A modular inserts per section 2.22.

C. Manufacturer:

1. Panduit
a. 48-Port Angled Patch Panel NKPPA48HDY
b. Or Equal

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with the Execution requirements of Section 270000.

3.02 EXAMINATION AND PREPARATION

A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the horizontal cables and terminations.

B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, “True Tape” the conduits).

C. Cable Integrity: Prior to installation, verify the cable’s integrity – both sheath and conductors. Documentation of pre-installation testing is not a close out requirement, and is the responsibility of the Contractor.

3.03 INSTALLATION

A. Backbone Cable Installation and Routing

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
2. Placement
   a. Place cables within designated pathways.
   b. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
   c. Maintain pulling tension within manufacturer's limits.
   d. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables if damaged during installation
   e. Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.
3. Routing
   a. When routing horizontally within telecommunications rooms, utilize the overhead cable support. When routing vertically within telecommunications rooms, utilize the vertical cable support and provide cable ties every 24 inches on center using.
   b. Route cables a minimum of 6" away from power sources to reduce interference from EMI.
   c. Termination
   d. Provide 15 feet cable slack loop at each end of the run. Store slack in overhead cable support or as noted on Drawings.
   e. Properly relieve strain from cables at termination points per manufacturer’s instructions.
   f. Terminate twisted pairs onto the termination apparatus in accordance with manufacturer’s latest instructions and TIA/EIA-568-B standard installation practices.
   g. Perform post-installation testing as described in the Telecommunication Testing specification.

B. OSP Interbuilding Backbone Cable

1. Cable runs shall have continuous sheath continuity, homogenous in nature, between either termination points or designated splices points. Only splices as noted on the Construction Documents are permitted.
2. Placement
    a. Place cables within designated pathways.
    b. Maintain a minimum bend radius of 6 times the cable diameter during installation.
    c. Maintain pulling tension within manufacturer's limits. Only use UL approved cable-pulling compounds when necessary to reduce pulling tensions.
    d. Protect cable during installation. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cable if damaged during installation.
    e. Neatly dress and organize cables in the cable routing facilities, and fastened to support devices via tie wraps.
    f. Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.
3. Routing:
    a. When routing horizontally within telecommunications rooms, utilize the overhead cable support; route backbone cables to avoid crossing over horizontal cabling or horizontal cabling crossing backbone cabling. When routing vertically within telecommunications rooms, utilize the vertical cable support and provide cable ties every 24 inches on center using.
    b. Route cables a minimum of 6" away from power sources to reduce interference from EMI.
4. Termination
    a. Provide 15 feet cable slack loop at each end of the run. Store slack in overhead cable support or as noted on Drawings.
    b. Properly strain relieve cables at designated points per manufacturer’s instructions.
    c. Terminate copper pairs at both ends on the specified <BEP> <termination apparatus>. Perform terminations in accordance with manufacturer’s instructions and TIA/EIA-568-B standard installation practices.
5. Labeling
    a. Provide labels on each end of the cable, no more than 4" from where the cable enters the specified splice closure or termination apparatus.
    b. Place labels such that they are visible by a technician from a normal stance

C. Duct Plugs
1. Provide blank plugs in unused ducts.
2. Provide multi-port duct plugs at duct ends with cables.
3. Provide cable plugs for each cable. Secure each twisted pair cable at each telecommunications vault, building entrance, and MPOE/ER with a cable plug sized depending upon the outside diameter of the cable.
4. Provide blank port plug in each used duct port.

D. Horizontal Cable Installation and Routing
1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.

2. Place cables within designated pathways, such as cable tray,, cable hangers, etc. Do not fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems.
3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.
4. Maintain minimum cable length of 15 meters from the termination in the TR to the termination at the user's faceplate (permanent link).
5. No cable length shall exceed 90 meters from the termination point in the TR to the termination point at the work area (permanent link).
6. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.
7. Do not exceed manufacturer's limits for pulling tension.
8. Do not use cable-pulling compounds for indoor installations.
9. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
10. Route cables under building infrastructure (such as ducts, pipes, conduits, etc); Do not route cables over building infrastructure. The installation shall result in easy accessibility to the cables in the future.
11. Place cables 6", minimum, away from power sources to reduce interference from EMI.
12. For 3" trade size conduits and larger, place a pull string along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull string (to prevent the string from falling into the conduit).
13. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via tie wraps or Velcro-type straps.
14. When exiting the primary pathway (such as cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

E. Cable Routing and Dressing within the TR
1. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on- center using cable ties.
2. At the rack bay, route cables into the back of the vertical management sections. Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination.
3. Provide 10 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack in the overhead cable support.

F. Termination in the TR/ER
1. Provide termination apparatus and accessories required for a complete installation. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
2. Properly strain relieve cables to and at termination points per manufacturer's instructions.

3. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the termination apparatus. Terminate twisted pairs compliant to T568Bwiring, per ANSI/TIA-568-C.0.
4. Modular Patch Panels and Horizontal Management Panels
    a. Provide quantity of modular patch panels in the TR rooms to support termination of cables served from respective TR. Provide quantity of horizontal management panels as shown on the drawings.
    b. In the ER, provide one 2U horizontal manager in each server cabinet and one 2U horizontal manager between each patch panel in the network patching cabinets plus one manager at the top and bottom of each patching cabinet.
    c. Install and assemble modular patch panels and horizontal management panels according to the manufacturer’s instructions.
    d. Install the patch panels and the horizontal management panels as shown on the Drawings.
5. Termination Sequence
    a. Backbone Cables: Terminate the backbone multipair cables to the modular patch panels 2 pairs per port. Terminate the 1st pair to pins 5/4 and the 2nd pair to pins 3/6 of the 1st port, etc. Leave pairs 25, 50, 75, and 100 open/unterminated.
    b. Horizontal Cables: Terminate the cables in sequential order using the link’s identifier starting at the top left and completing a panel before moving to the next panel below.

G. Cable Routing and Dressing at the Work Areas
1. Provide 10 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack within ceiling space neatly on a cable hanger
2. Routing to Furniture-feeds
    a. Route cables from primary or secondary pathway within ceiling through the furniture-feed pathway (stub within wall) into opening at bottom of furniture. Exercise caution to prevent scraping, cutting, or other damage to cable’s jacket.
    b. Provide spiral wrap around cables from furniture-feed pathway to point where cables enter furniture.
    c. Route cables from under-floor through pre-cut access floor panel into opening at bottom of furniture. Exercise caution to prevent scraping, cutting, or other damage to cable’s jacket.

H. Termination at the Work Areas
1. Provide device components, connectors, and accessories required for a complete installation. Install and assemble connectors, jacks, adapters, termination apparatus, accessories and associated management apparatus according to the manufacturer’s instructions.
2. Provide six inches, minimum, sheathed cable slack behind each workstation outlet faceplate. Coil the slack cable inside the raceway, within the wall, or in the junction box (if used), per the cabling manufacturer's installation standards.

3. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the connector compliant to T568B wiring, per ANSI/TIA-568-C.0.

I. Termination Apparatus (MPOE/EF)
1. Install the termination apparatus such that the bottom row of terminations is at a height as shown on the Drawings. If no height is shown, install bottom at 24" AFF (+/- 3").
2. Provide accessories required for a complete installation.
3. Mount blocks plumb and square.

J. Building Entrance Splicing Systems
1. Provide entrance splice system as shown on the Drawings, including closure, end caps, splice modules, grounding components, and accessories required for a complete installation. Install splice closure and splice modules per manufacturer's instructions using tools intended for the purpose.
2. Size enclosure based on splice bundle diameter, and size ends caps based on largest cable.
3. Include required accessories, such as collars, grommets, bushings, bonding connectors, etc. for a complete installation.
4. Thoroughly clean and separate binder groups prior to installing splice modules.
5. Apply sealant (such as B-sealant) to the end of the cable where the pairs exit the cable sheath – this to prevent water-blocking gel from leaking out the cable's sheath.
6. Provide labels on each splice module and binder group in splice closure.
7. Grounding and Bonding
    a. Bond splice enclosure and cable shield to closet busbar using bonding conductor per manufacturer's instructions and/or TIA-607 requirements.
    b. Provide 6 AWG bonding conductor up to 25 feet in length; if longer than 25 feet, size bonding conductor as 1000 circular mils per foot.
8. Fill unused end cap entry holes with appropriate plug (intended for purpose).
9. Attach splice enclosure to vertical cable runway on wall with metal straps.

K. Building Entrance Protection
1. Provide BEP system as shown on the Drawings, including terminals, modules, and accessories required for a complete installation. Install BEP per manufacturer's instructions.
2. Install BEP terminals plumb and square, and at height shown on Drawings. If no height is shown, install such that bottom row is at 24" AFF (+/- 3").
3. Grounding and Bonding
    a. Bond BEP terminal to TMGB in accordance with NEC Article 800, and follow the installation requirements described in Article 800.
    b. Provide 6 AWG bonding conductor up to 25 feet in length; if longer than 25 feet, size bonding conductor as 1000 circular mils per foot.
4. Labeling
    a. Provide and permanently affix label on the terminal's cover.
    b. Provide label in the label holder at the terminal's "outgoing" connection.

5. Provide quantity of protector modules to completely populate terminals..

L. Perform post-installation testing as described in the Telecommunication Testing specification (refer to Section 270811). Replace terminations and connectors not passing the required media test.

M. Patching Cords
   1. Provide the following number of fiber optic patch cords
      a. 125% of all ports = 1 MM Station Patch Cord per port
      b. 125% of all ports = Network Patch Cord per port
   2. Neatly dress patch cords within the horizontal and vertical management components. Store cord slack within the vertical management section.
   3. Provide the appropriate length patch cord at each location so there is not an abundance of slack or the patch cord is not pulled tight.
   4. Label both ends of each installed patch cord
   5. Turn over all unused patch cords to the owner at the end of the project

3.04 LABELING

A. General Requirements
   1. Labeling, identifier assignment, and label colors shall conform to ANSI/TIA/EIA-606-A Administration Standard and as approved by the Owner before installation.
   2. Permanent labels with machine-generated text (hand written labels will not be accepted).

B. Label Formats
   1. Horizontal Cable Labels
      a. Text Attributes: Black, 1/8” high, minimum, or #12 font size.
      b. Install labels on both ends of cables no more than 4" from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.
   2. Backbone Cable Labels
      a. Text Attributes: Black, 1/8” high, minimum, or #12 font size.
      b. Install labels on both ends of cables no more than 4" from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.
   3. Patch Panel Labels
      a. Use modular patch panel labels included in the product packaging. Request approval by the Engineer for other labels.
      b. Use a label color for the respective field type, per TIA/EIA-606.
      c. Text Attributes: Black, 3/32” high, minimum, or #10 font size.
   4. Termination Block Labels
      a. Use labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Owner.
      b. Use a label color for the respective field type, per TIA/EIA-606-A.
      c. Text Attributes: Black, 3/32” high, minimum, or #10 font size.
   5. Outlet Labels
      a. Use outlet labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Owner.

b. Label Background: White.
c. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
d. Install label in the top label window. Leave the bottom label window blank.

C. Identifier Assignment
1. General: Separate label fields as specified by Owner.
2. Horizontal Cables
a. Request standard from the Owner at the time of installation
3. Outlets
a. Request standard from the Owner at the time of installation
4. Individual Ports at the Outlets
a. Request standard from the Owner at the time of installation
5. Individual Termination Positions at Termination Blocks
a. Request standard from the Owner at the time of installation
6. Individual Ports at Patch Panels
a. Request standard from the Owner at the time of installation

3.05 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00.

B. Remove cables and replace with new those failing to meet the indicated standards and not passing the testing requirements of Section 270811 with no impact to cost and schedule. The Owner, will not accept the installation until testing has indicated a 100% availability of all cables and conductors. Any deviation from this requirement must be approved in writing by the Owner.

C. Comply with system acceptance and certification requirements of Section 27 00 00.

END OF SECTION 27 1313

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SECTION 27 13 23
COMMUNICATIONS FIBER OPTIC CABLING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. Backbone ISP (indoor) and OSP (outdoor) fiber optic cabling

B. Related Sections
   1. Comply with the Related Sections paragraph of Section 27 00 00.
   2. 270821 Communication Fiber Optic Testing

1.02 REFERENCES

A. Comply with References requirements of Section 27 00 00.

1.03 DEFINITIONS

A. Refer to Section 270000 for Definitions.

B. In addition to those Definitions of Section 27 00 00, the following list of terms as used in this specification defined as follows:
   1. “MM”: Multimode [fiber type]
   2. “OFCP”: Optical Fiber Conductive Plenum, plenum rating
   3. “OFCR”: Optical Fiber Conductive Riser, non-plenum riser rating
   4. “OFNP”: Optical Fiber Non-conductive Plenum, plenum rating
   5. “OFNR”: Optical Fiber Non-conductive Riser, non-plenum riser rating
   6. “OFN”: Optical Fiber Non-conductive, general purpose indoor rating
   7. “OSP”: Outside Plant
   8. “PVC”: PolyVinyl Chloride
   9. “SM”: Singlemode [fiber type]

1.04 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections
   1. Pathways: The communications pathways (backbone conduits, riser sleeves, basketway, cable tray, etc.) work will be covered under another Section. Refer to the drawings for size/capacity and route information.
   2. Rooms: Build out (e.g., backboards, overhead and vertical cable support, etc.) of the telecommunications rooms will be covered under another Section. Refer to the drawings for build out information.

B. Base Bid Work
   1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working telecommunications backbone fiber optic cabling system installation described in these specifications and shown on related drawings.

2. The drawings are diagrammatic in nature, and require shop drawings to complete the detailed design of the telecommunications infrastructure.
3. Consider Backbone cabling, as shown on drawings, as base bid work, unless otherwise noted, including terminations at both ends.
4. In general, the base bid work includes:
    a. Submittals
    b. Backbone inside plant (riser) fiber optic cables and terminations
    c. Innerduct
    d. Cable management
    e. Crossconnections / patching
    f. Cable identification tags and system labeling
    g. Record Documents
    h. Warranty

1.05 SUBMITTALS

A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.
B. Submittal Requirements Prior To Start Of Construction:
    1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
    2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.
    3. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations
C. Submittal Requirements at Closeout:
    1. Copy of the manufacturer's printed reel documentation, including the following.
        a. Manufacturer's reel number
        b. Manufacturer's traceable batch number
        c. Length of the fiber cable on the reel
    2. As-Built Drawings
    3. O & M Manuals
D. Substitutions
    1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.06 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.
B. Contractor Qualifications
    1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of

certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.08 WARRANTY

A. The backbone fiber optic cabling system, as specified in this section, shall carry a 15- year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover optical performance of cabling system.

PART 2 - PRODUCTS

2.01 FIBER OPTIC PATCH CORDS

A. Application
   1. Fiber optic patch cords shall be suitable for indoor installation within a telecommunications room within and/or between fiber patch panels.
   2. Cord shall be assembled from a single, continuous length of cordage, homogenous in nature; Splices are not permitted.

B. Cordage – Multimode 50/125um
   1. Conductors: Two 50/125um multimode tight-buffered fibers.
   2. Strength Element: Aramid yarn (Kevlar).
   3. Jacket: Flame-retardant PVC, or equivalent, in a ‘zipcord’ configuration.
   4. NEC rated as OFN (or higher), and UL listed as such.

C. Cordage – Singlemode
   1. Conductors: Two singlemode tight-buffered fibers.
   2. Strength Element: Aramid yarn (Kevlar).
   3. Jacket: Flame-retardant PVC, or equivalent, in a ‘zipcord’ configuration.
   4. NEC rated as OFN (or higher), and UL listed as such.

D. Connectors
   1. Multimode patch cords shall be either terminated via duplex LC connectors at both ends or terminated via duplex LC connectors to connect with the cable plant and via the connector type as required for connection to equipment.
   2. Singlemode patch cords shall be either terminated via duplex LC Ultra PC connectors at both ends or terminated via duplex LC-UPC connectors to connect with the cable plant and via the connector type as required for connection to equipment

E. Connector Loss
   1. Multimode: 0.5dB per mated pair at both 850nm and 1300nm.
   2. Singlemode: 0.5dB per mated pair at both 1310nm and 1550nm.

F. Manufacturer:

1. Corning Cable Systems
    a. #050502C5120003F; 2 strand MMF, duplex LC –to– duplex LC, 3 foot
    b. #050502C5120005F; 2 strand MMF, duplex LC –to– duplex LC, 5 foot
    c. #050502C5120007F; 2 strand MMF, duplex LC –to– duplex LC, 7 foot
    d. #050502C5120009F; 2 strand MMF, duplex LC –to– duplex LC, 9 foot
    e. #050502C5120015F; 2 strand MMF, duplex LC –to– duplex LC, 15 foot
    f. #040402R5120003F; 2 strand SMF, duplex LC-UPC –to– duplex LC-
    g. UPC, 3 foot
    h. #040402R5120005F; 2 strand SMF, duplex LC-UPC –to– duplex LC-
    i. UPC, 5 foot
    j. #040402R5120007F; 2 strand SMF, duplex LC-UPC –to– duplex LC-
    k. UPC, 7 foot
    l. #040402R5120009F; 2 strand SMF, duplex LC-UPC –to– duplex LC-
    m. UPC, 9 foot
    n. #040402R5120015F; 2 strand SMF, duplex LC-UPC –to– duplex LC- UPC, 15 foot
2. Or equal

2.02 FIBER OPTIC PATCH PANELS

A. Application:
1. Fiber optic patch panels shall be an enclosed housing for protecting, storing and organizing the termination of fiber cable(s) and fiber strands, shall provide means to strain relieve and support of the specified cables, shall contain facilities to store fiber slack, and shall provide patch cord management.
2. Fiber optic patch panels shall be passive physical equipment and apparatus used in terminating, interconnecting, and cross-connecting fiber optic cabling, shall possess a minimum fire resistant rating of UL94V-1, and shall conform to existing OSHA Health and Safety Laws.
3. Fiber optic patch panels shall be rack-mountable.

B. Fiber optic patch panels shall come equipped with safety labels such as laser identification or warning labels as required by system considerations.

C. Manufacturer:
1. Corning Cable Systems
    a. #PCH-01U; “Pretium Closet Housing” type patch panel, 1U, holds 2 adapter modules
    b. #CCH-CP24-E4; Adapter Module e/w 12 duplex MM LC aqua adapters
    c. #CCH-CP24-A9; Adapter Module e/w 12 duplex SM LC blue adapters
    d. #CCH-UM24-05-93Y; “Plug & Play” module e/w two MTP to duplex LC adapters
    e. #FAN-GT25-12, Fan out kit
    f. #FDC-CABLE-GRND, Cable Ground Lug
2. Or Panduit equal

2.03 FIBER OPTIC CONNECTORS

A. Multimode Fiber Optic Connectors – LC Type
   1. Materials:
      a. Ferrule: ceramic with pre-radiused finish/face
      b. Connector Housing: Plastic
   2. Connector shall have an integral strain relief feature, including a bend limiting rear boot.
   3. Connector shall be installable via either epoxy or anaerobic method.
   4. Manufacturer:
      a. Corning Cable Systems
         1) #95-051-98-SP; LC type connector, ceramic ferrule, for 50/125 µm MM, aqua boot
      b. Or equal

B. Singlemode Fiber Optic Connectors – LC Type
   1. Materials:
      a. Ferrule: ceramic (zirconia or alumina) with pre-radiused finish/face
      b. Connector housing: plastic
   2. Connector shall meet or exceed Ultra PC performance (LC-UPC).
   3. Connector shall have an integral strain relief feature, including a bend limiting rear boot.
   4. Connector shall be installable via either epoxy or anaerobic method.
   5. Manufacturer:
      a. Corning Cable Systems
         1) #95-201-98-SP; LC type connector, ceramic ferrule, SM, blue boot
      b. Or equal

2.04 LABELS

A. Cable Labels
   1. Labels shall be machine-printable via a laser printer, ink jet printer, thermal transfer printer, or hand-held printer
   2. Labels shall be adhesive-backed and have a self-laminating feature.
   3. Color (print area): White.
   4. Manufacturer:
      a. Panduit
         1) #S200X225YAJ; laser/ink jet labels, 2”x2.25”, for cable diameters 0.24”- 0.48”, white
         2) #S200X400YAJ; laser/ink jet labels, 2”x4”, for cable diameters 0.32”- 0.95”, white
      b. Or equal

2.05 MISCELLANEOUS

A. Fiber Slack Storage Reel
   1. Manufacturer

a. Leviton
1) #48900-OFR, large fiber storage reel
2) Or equal

B. Velcro Cable Ties 1. Width: .75".
2 Color: Velcro cable ties the same color as the cable to which it is being applied.
3 Manufacturers:
a. Panduit
1) #HLS-15R-0 Black, 15' roll, cut to length.
b. Or equal

C. D-Rings
1. Manufacturer
a. CPI
1) #10941-000, Small D-Ring
2) #10942-000 Medium D-Ring
3) #10943-000, Large D-Ring
4) Or Equal

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with Execution requirements of Section 270000.

3.02 EXAMINATION AND PREPARATION

A. Pathways: Prior to installation verify pathways (conduits, etc.) and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).

B. Rooms: Prior to installation, verify equipment rooms are ready for cables and terminations.

C. Prior to installation, verify cables and conductors are fully operational – both cable sheath and fiber strands. Pre-installation testing is the responsibility of the Contractor, though documentation of pre-installation testing is not a close out requirement.

3.03 INSTALLATION

A. OSP Fabric Innerduct and Duct Plugs
1. Provide three 3-cell fabric multi-cell innerduct in the OSP conduits shown on the site plan.
2. Secure innerduct at each telecommunications vault, building entrance, and EF per the manufacturers written instructions.
3. Plugs
a. Provide water tight split plugs in conduits with textile innerduct at duct ends in vaults, pull boxes MPOE, and EF rooms.
b. Provide blank port plug in each used duct port.

B. Backbone Cable Installation, Routing, and Termination

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
2. Placement
   a. Place OSP fiber optic cables within OSP innerduct.
   b. Place cables within designated pathways.
   c. Innerduct
      1) The standard cables to the TRs shall not be placed in innerduct.
      2) `Place cables that route between buildings in fabric innerduct.
   d. Maintain a minimum bend radius of 20 times the cable diameter during installation, and a minimum bend radius of 10 times the cable diameter after installation.
   e. Maintain pulling tension within manufacturer's limits.
   f. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
   g. Do not use cable-pulling compounds for indoor installations.
   h. Provide 20 to 30 feet of cable slack at each end within the Telecommunications Rooms; store slack in fiber slack storage reel mounted on the wall.
   i. Place a pull rope along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull rope.
3. Routing
   a. Within Telecommunications Rooms, neatly dress and organize cables on designated cable support apparatus (for example, overhead and vertical cable support), and fasten cables to cable support apparatus via tie wraps or Velcro-type straps.
4. Termination
   a. Properly relieve strain from cables at termination points (at/within the fiber optic termination panels) per manufacturer’s instructions.
   b. Provide breakout kits to furcate fibers from buffer tubes.
   c. Terminate fiber strands via direct connectorization at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Fiber strands may also be terminated via pigtail splicing using the specified fiber optic pigtail appropriate for the mode type of the fiber. For pigtail
   d. splicing termination method, splice shall be fusion; mechanical splicing will not be accepted.
   e. Provide required accessories and consumables for the complete termination of fiber strands.
   f. Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the ‘routing rings’, per manufacturer’s instructions.

C. Fiber Optic Cable Termination Panel
   1. Provide fully assembled termination panel in designated equipment rack; locate per drawings (if not shown, locate at the top). “Fully assembled” includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.
   2. Provide accessories required for proper installation of each termination panel, including connector panels and adapters.

D. Fiber Optic Patch Cords
   1. Provide the following number of fiber optic patch cords
      a. 700 MM Patch Cords
      b. 130 SM Patch Cords
   2. Neatly route patch cords between equipment and patch panels using available cable management
   3. Provide the appropriate length patch cord at each location so there is not an abundance of slack or the patch cord is not pulled tight.
   4. The owner and engineer will provide a patch cord cut sheet at a later time.
   5. Label both ends of each installed patch cord
   6. Turn over all unused patch cords to the owner at the end of the project

3.04 LABELING

A. General Requirements
   1. Labeling, identifier assignment, and the label colors shall conform to the TIA/EIA- 606-A Administration Standard and as approved by Owner or Owner’s Representative before installation.
   2. Provide permanent and machine generated labels; hand written labels will not be accepted.

B. Cable Labels
   1. Label Format:
      a. Label type shall be wrap-around self-laminating.
      b. Label color shall be white background with clear laminating window.
      c. Text color shall be black; text height shall be 1/8” high, minimum, or #12 font size.
   2. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

C. Termination Apparatus Labels
   1. Use labels included in the product packaging. For substitutions, request approval by the Engineer.
   2. Label color shall match respective field type, per TIA/EIA-606-A.
   3. Text color shall be black, 3/32” high, minimum, or #10 font size.

D. Identifier Assignment
   1. General: Separate all label fields of the identifier with a hyphen.

2. Backbone ISP Fiber Optic Cables
    a. The first field shall identify the cable type: “CBF” (for Cable, Backbone, Fiber optic).
    b. The second field shall identify the originating termination room identifier as shown on the plans; e.g., “TRF2.1”.
    c. The third field shall identify the ending termination room identifier as shown on the plans; e.g., “TR2.2”.
    d. The fourth field shall identify the type and number of strands; for example, “Mxxx” where “M” stands for multimode and xxx stands for the ending fiber strand sequential count
    e. Identifier Example: “CBF–TR2.1–TR2.2–M025-M048”
3. Termination Positions at the Termination Panels
    a. Make the first field of the identifier the destination room; for example “TO TR2.2”.
    b. Make the second field of the identifier the strand count range; for example, “M025-M048”
    c. Identifier Example: “TO TR2.2 M025-M048”.

3.05 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00.

B. Remove and replace with new, at no additional cost, cables with conductors failing to meet the indicated standards and not passing the testing requirements of Section 27 08 21. The Owner, or Owner’s Representative, will not accept the installation until testing has indicated a 100% availability of cables and conductors or the Owner or Owner’s Representative has approved in writing any deviation from this requirement.

C. Comply with system acceptance and certification requirements of Section 27 00 00.

END OF SECTION 27 1323

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SECTION 28 0000
SECURITY BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. The requirements described herein include the following:
   1. References
   2. Definitions
   3. System Description
   4. Submittals
   5. Quality Assurance
   6. Product Delivery, Storage, and Handling
   7. Project Management and Coordination Services
   8. Warranty
   9. Maintenance

C. Related Sections:
   1. Consult other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
   2. Section 27 08 11 – Twisted Pair Cabling
   3. Section 28 08 00 – Security System Acceptance Testing
   4. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, and bollard foundations. Refer to Division 2.
   5. Concrete Work: Include forming, steel bar reinforcing, cast in place concrete, finishing and grouting as required for underground conduit encasement, pedestal foundations, and curbs (also includes saw-cutting of existing slabs and grouting of conduits in saw-cut).
   6. Miscellaneous Metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, equipment enclosures, cameras, and similar devices. Refer to Division 5.
   7. Moisture Protection and Smoke Barrier Penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. Tape and make vapor tight penetrations through vapor barriers at slabs on grade. Refer to Division 7.
   8. Locking Hardware: Include interface to electronic hardware and door controllers on security related doors. Refer to Division 8.
   9. Access Panels and Doors: Required in walls, ceilings, and floors to provide access to security devices and equipment.

10. Painting: Include surface preparation, priming and finish coating as required for security cabinets, exposed conduit, pull and junction boxes, and devices where indicated as field painted in this Division. Refer to Division 9.

1.2 REFERENCES

A. General
1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.
2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.
4. SEE DECISION MATRIX UNDER SECTION 270000 FOR ALL SCOPE OF WORK RESPONSIBILITIES.

B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
1. United States Department of Labor (DOL) Regulations (Standards - 29 CFR)
   a. Part 1910 – Occupational Safety and Health Standards
2. National Fire Protection Agency (NFPA)
   a. NFPA 70 – National Electrical Code (NEC)
   b. NFPA 75 – Protection of Information Technology Equipment
3. Uniform Building Code (UBC)
4. Uniform Fire Code (UFC)
5. Uniform Mechanical Code (UMC)
6. National, State, Local and other binding building and fire codes
7. FCC Regulations:
   a. Part 15 – Radio Frequency Devices & Radiation Limits
   b. Part 68 – Connection of Terminal Equipment to the Telephone Network

C. Standards: Perform Work and furnish materials and equipment under Division 28 in accordance with the latest editions of the following standards as applicable:
1. Underwriter's Laboratories (UL): Applicable listing and ratings.
   a. UL 294 – Access Control System Units
   b. UL 1076 – Proprietary Burglar Alarm Units and Systems
   c. UL 2044 – Commercial Closed-Circuit Television Equipment

1.3 DEFINITIONS

A. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:
   1. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories.
   2. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Complete installation and make ready for regular operation.
   3. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation.
   4. "Connect": To install required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
   5. "As directed": As directed or instructed by the Owner, or their authorized representative.
   6. "Cabling": A combination of cables, wire, cords, and connecting hardware (e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling).
   7. "SEC": Security Equipment Cabinet
   8. "SJB": Security Junction Box
   9. "ACAMS": Access Control & Alarm Monitoring System
   10. "DCS": Detention Control System
   11. "IDS": Intrusion Detection System
   12. "NVR": Network Video Recorder
   13. "VSS": Video Surveillance System

1.4 SYSTEM DESCRIPTION

A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality. New systems must integrate with existing facility security systems.

1.5 SUBMITTALS

A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. Contractor Qualifications
   1. Resumes of the Project Manager, General Foreman, and Lead Technician(s) indicating role, years of experience, product certifications and training, listing of similar projects the individual performed the role proposed for this project along with client contact information for each.
   2. Certification letters stating the Contractor is an authorized reseller, installer, and extended warranty provider for the following systems:
      a. ACAMS manufacturer & certification level
      b. VSS manufacturer & certification level

C. Product Data

1. Obtain written approval from the Engineer for the product data submittal prior to the release of materials and equipment purchase order and prior to installation.
2. Quantity: Submit product data submittals as described in Division 1.
3. Format:
   a. Minimum Format: Submit each product data submittal in an 8-1/2 x 11 inch folder. Product data submittal shall be in a 3-ring binder (or similar). If in a 3-ring binder, insert the submittal information the transparent front cover and spine pockets.
   b. Clearly label the cover and spine of each submittal with the following information:
      1) Client Name
      2) Project Name and Address
      3) Project Submittal Number
      4) Submittal Name (e.g., "Product Data Submittal for Video Surveillance System")
      5) Specification Section Number (e.g., "Section 28 23 00")
      6) Date of Submittal Format: <month> <day>, <year> (e.g., "January 1, 2014")
      7) Contractor Name
   c. Include a Table of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., "2.02-A Network Video Recorders").
   d. Include tabbed separators for improved navigation through the submittal.
4. Content:
   a. Cover Letter: Product data submittals shall include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Sign (and stamped, if applicable) cover letter and list items and data submitted. Have the person who prepared the submittal sign the document as well. Failure to comply with this requirement shall constitute grounds for rejection of submittal.
   b. Product Information: Product Data submittal shall consist of manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary). This data shall clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in the Division 28 specifications. Include relevant products that will be installed, which are not listed in the specifications.
   c. Re-submittals: Provide a cover letter with the re-submittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. No review shall take place for any re-submittal packages that is not accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the re-submittal package.

D. Shop Drawings
   1. Obtain written approval from the Engineer for the shop-drawings submittal prior to the release of materials and equipment purchase order and prior to installation.
   2. Quantity and Media: Submit shop-drawings as described in Division 1.

3. Format:
    a. Produce shop drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.
    b. Use the same size drawing sheet as the drawings of the Contract Documents.
    c. Text: minimum of 3/32" high when plotted at full size.
    d. Screen background information.
    e. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
    f. Scaling:
        1) Scale floor plans at 1/8"=1'-0"
        2) Scale enlarged room plans at 1/4"=1'-0"
        3) Scale wall elevations at 1"=1'-0"
4. Content:
    a. Submit shop drawings that represent proposed installation of security system.
    b. Floor Plans: Scale floor plans at 1/8"=1'-0". Floor plans shall show:
        1) Locations and identifiers of security devices.
        2) Size, quantity, location and proposed routes of security cabling.
        3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).
    c. Point to Point Diagrams: Include wiring, points of connection and interconnecting devices.
    d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.
    e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
    f. Proposed mounting details

E. As-Built Drawings
1. Quantity and Media: Submit as-built drawings as described in Division 1.
2. Format:
    a. Produce as-built drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.
    b. Use the sheet size as the drawings of the Contract Documents, and use the project title block.
    c. Text: minimum of 3/32" high when plotted at full size.
    d. Use symbols identical to the symbols shown on the Drawings.
    e. Screen background information.
    f. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
3. Content:
    a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.
    b. Floor Plans: Scale floor plans at 1/8"=1'-0". Floor plans shall show:
        1) Locations and identifiers of security devices.
        2) Size, quantity, location and proposed routes of security cabling.
        3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).

c. Point to Point Diagrams: Include wiring, points of connection and interconnecting devices.
d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.
e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
f. Custom mounting details

F. Operation and Maintenance (O&M) Manuals
1. Quantity: Submit quantity of O&M Manuals as described in Division 1.
2. Format:
a. Submit each O & M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.
b. Clearly label the cover of each O&M Manual with the following information:
1) Client Name
2) Project Name and Address
3) Manual Name (e.g., “Operation and Maintenance Manual for Video Surveillance System”)
4) Date of Submittal Format: <month> <day>, <year> (e.g., “January 1, 2010”)
5) Contractor Name
c. Include a Table of Contents at the beginning that lists the contents.
d. Include tabbed separators for improved navigation through the manual.
3. Content:
a. 11”x17” prints of as-built drawings, as described above
b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)
c. Warranty certificate from the manufacturer and the Contractor
d. Manufacturer’s instructions for system or component use
e. Instructions and requirements for maintenance and warranty issues
4. Contents shall include requirements and methods for maintaining installed products.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications
1. A current, active, and valid and Oklahoma State Contractors License
2. Minimum five years experience in installation and service of access control, video surveillance, and intrusion detection systems.
3. Minimum five completed projects similar to scope and cost.
4. Evidence of technicians qualified for the work in the form of current manufacturer’s training certification.

B. Materials
1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials.
2. Use specified products and applications, unless otherwise submitted and approved in writing.

C. Regulatory Requirements
1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 28 shall confirm to the most stringent of the applicable codes.
2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

D. Drawings
1. Follow the general layout shown on the Drawings except where other Work may conflict with the Drawings.
2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.
3. The Drawings do not fully represent the entire installation for the security system. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

1.7 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. Project Management and Coordination Services
1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.
2. Review of Shop Drawings Prepared by Other Subcontractors:
   a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with Work.
   b. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 28 contract documents. Document discrepancies or deviations as follows:
      1) Prepare memo summarizing the discrepancy
      2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy
   c. Prepare and maintain a shop drawing review log indicating the following information:
      1) Shop drawing number and brief description of the system/material
      2) Date of the review
      3) Name of the individual performing the review
      4) Indication if follow-up coordination is required

B. Role of the Engineer
1. During the construction phase of the project, the Engineer will work with the Contractor to provide interpretation and clarification of project contract documents, reply to (and 'process') relevant Requests for Information (RFIs), and act as an interface between the Contractor and the Owner.

2. The Owner has retained the Engineer's services to observe the Work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system.
3. In general, the Engineer will participate during the construction phase as follows:
   a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.
   b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
   c. Interpret field problems for Owner, and translate between Owner and Construction Team.
   d. Review the testing procedures to confirm compliance with industry-accepted practices.

C. Use of CAD Files
1. Should the Contractor need the Engineer's CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery
1. Do not deliver security system components to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable.
2. Replace equipment damaged during shipping and return to manufacturer at no cost to the Owner.

B. Storage
1. Store materials in a clean, dry, ventilated space free from temperature extremes.
2. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
3. Provide heat where required to prevent condensation or temperature related damage.

C. Handling
1. Handle in accordance with manufacturer's written instructions.
2. Prevent internal component damage, breakage, denting and scoring. Do not install damaged equipment. Replace damaged equipment and return equipment to manufacturer.

1.9 WARRANTY

A. Provide the Security System as described in this specification with a one year parts and service warranty at no additional cost to the Owner.

B. Include in the warranty package, at a minimum, the following:
1. Software support agreement for the ACAMS and VSS
2. Software upgrades and patches
3. Labor to install software upgrades and patches necessary to maintain the latest version
4. Emergency service on regular working hour basis

5. Service by factory trained and employed service representatives of system manufacturer

C. Maintain regular service facilities and provide a qualified techni¬cian familiar with this work at the site within four (4) hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by the Owner, complete and operational within twenty four (24) hours after notification of a malfunction, at no additional cost.

D. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to the Owner, for the duration of such off site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.

1.10 MAINTENANCE

A. Extra Materials
1. Deliver extra materials to a secured location determined by the Owner.
2. Provide a complete Bill of Materials listing quantities, part numbers, and descriptions for each device for the Owner to sign indicating receipt of equipment.
3. Provide new and unused spare parts in their original packing materials upon delivery.

B. Maintenance Service
1. Provide software and firmware updates issued free of charge by the manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

A. Material and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the included systems. Where a particular material, device, equipment or system is specified directly, the current manufacturer's specification for same is a part of these specifications, as if completely elaborated herein.

B. Use standard, regularly manufactured, materials and equipment for this and/or other similar systems, and not custom designed especially for this project. Provide systems and components thoroughly tested and proven in actual use. Provide subsystems of one manufacturer.

2.2 SUBSTITUTIONS

A. Conform to the general requirements and procedure outlined in Division 1 in the Request for Substitution.

B. Only one substitution allowed for each product specified.

C. Where products are noted as "or equal", a product of equivalent design, construction, and performance will be considered. Submit product data – catalog cuts, product information, and pertinent test data –required to substantiate that the product is in fact equivalent to that specified. The burden of proof rest with the Contractor that the substituted product is equivalent to the specified product.

D. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).

E. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

F. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the Work, or from provisions of the Specifications.

G. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports and devices have been removed.

C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, “True Tape” the conduits to verify cable distances.

3.2 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Perform the Work using skilled technicians under the direction of the foreman. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule. Do not change the supervisor during the project without prior written approval from the Owner.

B. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion and inspection as required.

3.3 INSTALLATION

A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.

B. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.

C. Manufacturer's Instructions:
1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

D. Boxes, Panels, and Enclosures
1. Install boxes, panels, and enclosures square and plumb.
2. Set "flush mounted" units with the face of the cover, bezel or escutcheon in the same plane as the surrounding finished surface.
3. Mount boxes, panels and trim so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.
4. Install insulating terminations in signal circuit boxes, panels, wireways or enclosures.

E. Painting
1. Custom paint devices as indicated on the drawings.

3.4 REPAIR/RESTORATION

A. Replace or repair work completed by others that you deface or destroy, at not cost to the Owner.
1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.
2. Provide punch list to Engineer for review prior to performing punch walk with the Engineer.

B. Re-Installation:
1. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
2. Repair defects prior to system acceptance.

C. Painting: Repaint surfaces altered during installation of the security system to match previous conditions.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

END OF SECTION 28 0000

SECTION 28 0553

SECURITY SYSTEM LABELING

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:
   1. Labeling of wire, cable, security devices, enclosures, and raceways.

C. Related Sections:
   1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, warranty, and installation requirements.

1.2 SUBMITTALS

A. Product Data: Submit the following:
   1. Product information for components specified herein.
   2. List of equipment (wire, cable, devices, enclosures, and raceways) and the corresponding text for the label.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.

2.2 LABELS

A. Wire and Cable Labels:
   1. General
      a. Self-laminating adhesive laser labels.
      b. Machine printable with a laser printer.
      c. Cable size: 0.16 – 0.32” OD
      d. Color: white with black lettering
   2. Manufacturer:
      a. Brady #WML–211-295 and #WML-311-292 wire marking labels
      b. Or equal

B. Device Labels:
   1. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements
   1. Label the security system components. The components include, but are not limited to, the following:
      a. Equipment Enclosures
      b. Conduits
      c. Security Devices
      d. Batteries
      e. Wires and Cables
      f. Equipment Racks
      g. Terminal Blocks
      h. Relays
      i. Patch panels, and the termination positions within the patch panels.
   2. Labels to coincide with device IDs used on the record drawings.
   3. Degrease and clean surfaces to receive nameplates and labels
   4. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.

B. Equipment Cabinets
   1. Label SEC enclosures associated with the security system with a nameplate.
   2. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.
   3. Example: Line 1: "SEC-01" (1/2 inch high letters) Line 2: "Security Equipment Cabinet" (1/4 inch high letters)

C. Conduits
   1. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.
   2. Example: "To SEC-01"

D. Security Devices
   1. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12 point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.
   2. Label each device in a concealed location with the system point number and address.

E. Batteries
   1. Label power supply batteries with the month and year they were installed.
   2. Example: "January 2018"

F. Wire and Cable

1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within one (1) inch of each connection.
2. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.
3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable to carry the same labeled designation over its entire run, regardless of intermediate terminations.
4. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within six (6) inches of the point of exit.
5. Positional labels so they are clearly visible without the need to remove wire management or other obstructions.
6. Label cables at both ends of a run and within pull and junction boxes using machine generated wrap-around labels.

3.2 CABLE LABEL FORMAT

A. From Panel to Field Device
   1. Line 1: Device Type and Device Number
   2. Line 2: Panel ID – Port Number
   3. Example: CR 033 PANEL 2 – CR1
   4. Standard Device Types
      a. CR = Card Reader
      b. K = Camera
      c. ET = Entry Telephone
      d. R = Relay Output
      e. A = Alarm Point
   5. Standard Port #s
      a. CR = Reader
      b. M = Monitored Input
      c. R = Relay Output

B. From Door Junction Box to Card Reader
   1. Line 1: Device Type and Device Number
   2. Line 2: Panel ID – Port Number
   3. Example: CR 033 PANEL 2 – CR1

C. Miscellaneous Examples:
   1. From Door Junction Box to Door Contact
      a. CR033
      b. DC
   2. From Door Junction Box to Rex Alarm
      a. CR033
      b. REX ALM
   3. From Panel to Rex
      a. CR033
      b. REX PWR
      c. 12 VDC
   4. From Panel to Lock
      a. CR033
      b. LCK PWR

c. 24 VDC

D. Communications Cable
1. Line 1: Communication Type and Direction
2. Line 2: Panel ID
3. Example:

RS-485 TO
PANEL 2

4. Typical Communication Types
a. RS-485
b. RS-232
c. RS-422

END OF SECTION 28 0553

SECTION 28 0800

SECURITY SYSTEM ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 GENERAL

A. Furnish engineering, labor, materials, apparatus, tools, equipment, and transportation required to thoroughly test the completed security system installation as described in these specifications.

B. Full testing of a completed security system which includes:
   1. Develop, submit, and obtain Engineer's approval of security system Pre-Functional and Functional testing forms.
   2. Complete 100% Pre-Functional test of the security system. Submit Pre-Functional testing documentation reflecting that all security devices, cabling, locking hardware, power, interfaces to other systems, network switches, servers, workstations, and other components required for a completely functional security system are provided per project documents.
   3. Complete 100% Functional test of the security system. Submit Functional testing documentation reflecting that all security equipment, components, interfaces, and programming are functioning correctly per project documents. Upon receiving approval of functional testing documentation, schedule final acceptance testing activities to be witnessed by Engineer and/or Owner.
   4. Demonstrate 100% security system functionality to the Engineer and Owner's IT and Security representatives. Document testing activities and submit with final As-Built drawing.

1.2 SUMMARY OF SYSTEM COMMISSIONING ACTIVITIES

A. Overview
   1. The purpose of system commissioning is to ensure the security system operates properly when it is needed most. Security systems are very complex from both an equipment and programming standpoint, and thorough testing is necessary to ensure correct operation.
   2. Perform testing activities after-hours or on weekends when the system is "quiet" and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the pre and final test results.

B. Pre-Functional Test
   1. Perform a 100% pre-functional test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system's operation to the Engineer and Owner's IT and Security representatives.

2. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports

C. Functional Test
1. Perform a 100% pre-functional test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system's operation to the Engineer and Owner's IT and Security representatives.
2. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports

D. Final Acceptance Test
1. Perform a final test of the system in the presence of the Engineer and Owner's IT and Security representatives to demonstrate correct operation of the security system.

1.3 SUBMITTALS

A. Operation and Maintenance Manuals
1. Functional Design Manual: Includes a detailed explanation of the operation of the system.
2. Hardware Manual which includes:
   a. Pictorial parts list and part numbers
   b. Pictorial and schematic electrical drawings of wiring systems, including devices, control panels, instrumentation and annunciators
   c. Telephone numbers for the authorized parts and service distributors
   d. Include service bulletins
3. Software Manual which includes:
   a. Use of system and applications software
   b. Initialization, start-up, and shut down procedures
   c. Alarm Reports
4. Operator's Manual which fully explains procedures and instructions for the operation of the system and includes:
   a. Computers and peripherals
   b. System start up and shut down procedures
   c. Use of system, command, and applications software
   d. Recovery and restart procedures
   e. Graphic alarm presentation
   f. Use of report generator and generation of reports
   g. Data entry operator commands
   h. Alarm messages and reprinting formats
   i. System access requirements
5. Maintenance Manual which includes:
   a. Instructions for routine maintenance listed for each component, and a multi-page summary of component's routine maintenance requirements.
   b. Detailed instructions for repair of the security system.
   c. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided and database capabilities.

d. A summary of the TCP/IP address used and which system component they are associated with. Include the gateway address, subnet mask, DNS server, and host name information.

6. Test Results Manual, which includes the document results of tests, required under this Specification, organized by System, Floor, and Door.
7. Record Drawings Manual which includes 11”x17” prints of record drawings as described below.

B. Record Drawings
1. Drawings to fully represent installed conditions including actual locations of devices, actual cable and terminal block numbering, and correct wire sizing as well as routing. Record changes in the work during the course of construction on blue or black line prints.
2. Include drawings submitted as part of the Shop Drawing package, plus additional information required to accurately document installed conditions.
3. Include the following additional information:
   a. Device addresses & IP address information.
   b. Settings for each camera (lens specs, mm setting, auto shutter setting, and other available camera settings, etc.)
4. Final acceptance will not be made until the Engineer approves the record drawings.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 SCHEDULING

A. Coordinate security commissioning with the General Contractor and provide specific information on pre-test and final-testing activities to be entered into the overall project construction schedule.

3.2 TESTING REQUIREMENTS

A. Site Tests
1. Perform a 100% pretest of the system prior to final testing by the Engineer. Provide the Engineer with a minimum of a 5 day notice prior to scheduling testing.
2. At the conclusion of the work on a floor, test the system on that floor to verify proper operation and reporting of devices.
3. Work with the door hardware supplier to resolve electric hardware failures and door alignment/closure problems.
4. At the completion of the work, test the entire system to verify proper operation. At a minimum, include these tests:
   a. Door Hardware Test: Coordinate with door hardware contractor to test electrified locking hardware of associated card reader doors.
   b. Intercom System Test: Test functionality of intercom station to automatically direct dial associated VOIP phone and rollover/backup

phones. Verify integration with ACAMS and detention control system to provide a virtual master station at desired locations.

c. Camera Test: Review cameras for proper coverage, resolution, frame rate, and overall quality of image.

d. Battery and UPS Load Test: Disconnect AC power to security system components to verify battery operation functions and system remains fully operational.

B. Test Preparation

1. Provide device identification numbers that differ from or were not included on the original contract drawing set.
2. Provide a complete systems point list.
3. Provide paper and toner for the printer so that an event log can be printed out and attached to the test reports as verification of test sequence and systems response.
4. During testing, provide a minimum of three technicians familiar with the installation to assist with the test. Stage the technicians as follows: one at the host, one at the device being tested, and one runner responsible to furnishing tools, step ladders, etc.
5. Provide radios for use by the Engineer and Owner during testing.
6. Provide pre-programmed access cards for use during testing. Provide one card for each access level.

3.3 TEST PROCEDURES

A. Refer to the test forms for testing procedures for each type of device/system.

3.4 DOCUMENTATION

A. Provide a full-sized drawing package containing a detailed wiring diagram (layout of equipment/elevation, complete parts list, and a complete wiring diagram for each access control panel) for each SEC location in the IDF rooms. Fold the diagram and place it inside a clear plastic pocket affixed to the inside door of the SEC.

B. Provide a service log on the inside door of each SEC. Include columns for the following information: date of service, description of work performed, service technician(s), and service company in the service log. Place the service log inside a separate clear plastic pocket affixed to the inside door of the SEC.

END OF SECTION 28 0800

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SECTION 28 1300
ACCESS CONTROL AND ALARM MONITORING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working Access Control & Alarm Monitoring system installation, as described in these specifications.

B. Contractor to provide 2 separate access control systems, one for the fire station and one for the police station.

C. Section Includes:
1. ACAMS software licenses
2. ACAMS control panels, input/output modules, and card readers
3. ACAMS power supplies
4. Alarm initiating devices, including: magnetic switch contacts, request-to-exit sensors, duress buttons, and general alarm points
5. Integration with the VSS and other security subsystems to allow bi-directional communication with one another
6. Interface to electric door hardware and ADA door operators
7. Interface to fire/life-safety system

D. Products Furnished and Installed Under another Section:
1. 120V power
2. Conduit and junction boxes
3. ADA door operators and push buttons
4. Fire/life-safety system interface relays
5. Network connectivity for ACAMS devices via Owner's local/wide area network

E. Related Sections:
1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
2. Section 28 00 00 – Security Basic Requirements: for submittal formats, warranty, general product requirements, and installation requirements.
3. Section 28 08 00 – Security System Acceptance Testing: for testing requirements.
4. Section 28 23 00 – Video Surveillance System: for interface requirement with the ACAMS.

1.2 SYSTEM DESCRIPTION

A. Overview

1. The ACAMS is a distributed network of control panels connected to and programmed from a owner host server and client workstations. The system also utilizes other software interfaces by other projects and systems for example; (The video system is not tied to the ACAMS system)
2. The ACAMS consists of redundant host servers located in the primary and secondary MDF rooms, client workstations, control panels, card readers, and alarm initiating devices. The host server communicates with the field panels via the Owner's local/wide area network.
3. Refer to Division 08 for door schedule and product information. All products listed in Division 08 to take precedence over products listed in this section.

B. Access Control & Alarm Monitoring System

C. Provide ACAMS software and associated licenses to support the devices shown on the project drawings.

D. Provide web browser client license (thin client) to allow for remote viewing on other workstations and or mobile devices.
1. Provide ACAMS control panels located in the IDF rooms as indicated on project drawings.
2. Panels support up to 64 card readers each with locking control outputs and multiple general purpose input/output modules for automation.
3. Provide smart card readers as indicated on project drawings.
4. Provide interface to latch position switch (LX) and request-to-exit (RX) switch within electrified door hardware for card reader controlled doors. Provide alarm contacts and request-to-exit motion detectors for card reader doors that do not contain LX and RX sensors within the electrified hardware set. Provide continuous updating of security details to match revised Div. 8 information as needed throughout the duration of the project. Refer to Section 08 71 00 – Door Hardware for additional requirements.
5. Provide 12/24VDC ACAMS device and lock power supplies as indicated on project drawings.
6. Provide battery backup of system components and power supplies.

E. ACAMS Integration Requirements (Owner Provided)

F. Interface to Fire/Life-Safety System
1. Coordinate with Fire/Life-Safety system contractor to automatically drop power from stairwell, elevator vestibule lobby, and other access controlled doors within the path of egress upon alarm activation of the Fire/Life-Safety system.

G. Tamper Monitoring
1. Provide additional monitor input points for monitoring the following:
    a. Tamper switches located within each security equipment enclosure (use unsupervised inputs for this purpose).
    b. Supervision of power supplies and batteries (use unsupervised inputs for this purpose).
    c. All unused dedicated tampers and AC power fail inputs must be jumpered to prevent false activation alarms.

H. Shop Drawings:
   1. Device placement on floor plans
   2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
      a. ACAMS control panel
      b. ACAMS card reader and input/output modules
      c. ACAMS power supplies
      d. Card Readers
      e. Alarm contacts and request-to-exit sensors
      f. Interface to electrified door hardware
      g. Interface to fire/life-safety system
      h. Cable conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
   3. Schedules: Provide schedules for ACAMS control panels that show each point ID with a description of the connected devices.
   4. Block Diagram/Riser Diagram: Show the ACAMS components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
   5. Custom mounting details

1.3 QUALIFICATIONS

A. The Contractor shall be a certified dealer of the specified manufacturers with a minimum of 5 year of experience.

B. Training: Programmer shall have received manufacturer-provided and/or manufacturer approved training in the configuration of the physical security system(s) being provided.

C. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the physical security system(s).

D. Submittal: Certification certificate shall be submitted with physical security system(s) submittals.

PART 2 - PRODUCTS

2.1 ACAMS SOFTWARE & SERVER (Match existing)

2.2 ELECTRONIC ACCESS CONTROL HARDWARE

A. The Access Control Panel (ACP) is used as the subcomponent to the security system for the purpose of initiating all decision-making criteria as it relates to the cardholders, readers, and associated hardware connected. Decisions are made by the ACP and uploaded to the host computer as historical events.

B. The ACP shall be listed for Underwriters Laboratory (UL):
   1. UL294 (Access Control System)

C. Manufacturer:
   1. Mercury LP1502 Series Controllers
   2. HID Mercury Security MR52 Interface Module

2.3 ACS HARDWARE COMPATIBILITY LIST

A. The ACS shall have an open architecture that supports the integration of third-party IP-based door controllers and IO modules. The ACS shall simultaneously support mixed configurations of access control hardware from multiple vendors.

B. The ACS shall support multiple types of hardware devices: Single-reader controllers, 2-reader controllers, 1- to 64-reader controllers, integrated readers and door controllers, Power-over-Ethernet (PoE) enabled door controllers.

C. The ACS shall support most industry standard card readers that output card data using the Wiegand protocol and Clock-and-Data.

2.4 MAPPING SOFTWARE

A. The ACS software shall be provided with native integrated mapping software.

B. The Contractor shall provide a satellite level screen shot map showing exterior devices. These maps shall include drill down links to access the building floor plans where all interior and exterior devices are shown. The overview satellite map shall show alarms signifying there is an alarm in the building to draw attention quickly to the correct building then floor plan.

C. The maps shall have links to the other levels/sections as well as the global map.

D. The floor plans shall include all access-controlled door and integrated devices.

E. The Contractor shall be responsible to provide all the labor to setup these maps and place all the devices.

F. The Contractor shall get sign-off from the Owner and Consultant on the finished maps.

G. The Contractor shall obtain the building plans from the Consultant for their use.

2.5 CONTACTLESS SMART CARD READERS

A. Utilize OSDP and not Wiegand.
   1. Credentials:
      a. Operating Frequency: 13.56 MHz (ISO 15693, 14443A & 14443B) and 125 KHz
      b. Contactless smart card reader shall implement the following high security 13.56 MHz applications out-of-box.
         1) Secure Identity Object on HID iCLASS SE
      c. Able to read 37-bit card format.
      d. Able to read NFC

2. Operating voltage range: 5-16 VDC
3. Current draw: 65mA average and 200mA peak @ 12VDC.
4. Color: Black
5. IP 55 exterior rated.
6. Provide adapter plate to mount on a single-gang mud ring as required.
7. Firmware upgradable via pre-programmed cards.
8. Provide the ability to transmit an alarm signal via an integrated optical tamper switch if an attempt is made to remove the reader.
9. An audio beeper and RGB light bar shall provide various tone and light sequences to signify: access granted, access denied, power up, and diagnostics.
10. Manufacturer
    a. HID iClass SE R40 for on-wall applications and R15 for mullion, RPK40 for security gate.

2.6 SURGE PROTECTION FOR LOW VOLTAGE AC/DC POWER

A. The Contractor shall provide a surge protector for all exterior devices being supplied by low voltage power. This does not include devices directly connected to a building where the risks of surges are negligible.

B. There shall be a minimum of a 36" shielded cable from the surge protector to the device to allow for adequate clamping time.

C. When protector is mounted in interior, dry or weather sealed enclosure:
1. Nominal voltage rating of 24V AC/DC. Provide correct module per required voltage level if different from 24V.
2. 20,000A surge current rating.
3. Protects 2-pair per module.
4. Accepts up to 10AWG cable
5. Connect directly to ground.
6. UL 497B listed
7. Provide quantity of modules as required for the application.
8. Provide base mounting plate as required for the application.
9. Manufacturer:
    a. Ditek DTK-2MB Mounting Base
    b. Ditek DTK-2MHLP24B Surge Module
    c. Or approved equal

2.7 SURGE PROTECTION FOR 120 VAC POWER

A. The Contractor shall provide a surge protector for all 120VAC supplied panels and enclosure when there is a critical risk of surges. This does not include interior panels which only serve interior devices or devices connected directly to a building where the risks of surges are negligible.

B. There shall be a minimum of a 36" of cable from the surge protector to the load to allow for adequate clamping time.

C. When the protector is mount in an interior or exterior location:
   1. Nominal voltage rating of 120VAC, single-phase, 20A continuous load.
   2. Series connected.
   3. 54,000 A surge current rating.
   4. 35db of EMI/RFI filtering.
   5. UL 1449 Type 2 SPD listed
   6. UL 1289 EMI/RFI Noise Filtering listed.
   7. LED indicator.
   8. Form C dry contacts for monitoring.
   9. Include with NEMA 4X enclosure.
   10. Maintain a minimum of 3' of cable from the surge protector to the load.
   11. Manufacturer:
      a. Ditek DTK-TSS4D

2.8 POWER SUPPLIES AND ACCESS CONTROL ENCLOSURES

A. Provide a power supply/chargers and sub-assemblies to power various access controller boards, locking hardware and other access control or security system components. The Contractor shall select the appropriate enclosure, power supply and sub-assemblies for each application. The Contractor shall include network monitoring modules for all power supplies.

B. Enclosures
   1. Shall be capable of accommodating power supplies, sub-assemblies and other manufactures access control controller boards when required.
   2. Wall mountable.
   3. Include a cam-lock and tamper switch.
   4. Trove 2 enclosures when housing access control electronics.
   5. eFlow or Maximal enclosures when only power supply components will be within the enclosure.
   6. Provide enclosure for all access controllers
   7. Include 25% spare capacity for future.
   8. Manufacturer:
      a. Life Safety Power (basis for design)

2.9 CABLES

A. Provide cabling per manufacturer's recommendations and code requirements for riser rated, plenum, and non-plenum cable types.

B. UTP data cabling required will be provided, installed, terminated and tested by the Division 28 security Contractor.

C. UTP patch cables will be provided and installed by the Owner in the IDF and provided by Owner and installed by Contractor at the door. The EACS Contractor shall provide the Owner a list of patch cable lengths at the door side.

D. Cables for electronic access controlled doors shall be bundled and include the followings conductor counts:
   1. Card reader – 6 conductor, 22 awg shielded.
   2. Lock power – 4 conductor, 18 awg unshielded.
   3. Door contact – 2 conductor, 22 awg unshielded
   4. Request to exit and/or latch detection/spare – 4 conductor, 22 awg unshielded

E. Manufacturer:
   1. Belden #658AFS
   2. Convergent #725116
   3. General Cable #4EPL1S

F. Cables for RS-485 shall be 24-AWG, 2-pair with 100% coverage aluminum foil shield and
   1. 90% coverage outer tinned copper braid shield.
   2. Manufacturer:
      a. Belden #9843

2.10 DOOR CONTACTS/DOOR POSITION SWITCHES (DC) (Reference division 08 for locations)

A. The Security Contractor shall be responsible for the connection of all door position devices to the access control system. Door position devices shall be integral to the door hardware whenever possible. The Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements.

B. Sealed and potted magnetic reed switch in contact housing.

C. Provide DPDT for applications with multiple security systems (Access Control/Intrusion Detection or PLC) utilizing a single door contact.

D. Provide color that matches door as close as possible.

E. Provide recessed switch whenever possible.

F. Armored whip for surface mount contacts.

2.11 REQUEST TO EXIT (REX) DEVICES (Reference division 08 for locations)

A. The Security Contractor shall be responsible for the connection of all request to exit devices integral to the door, motion based or other to the access control system. Request to Exit devices shall be integral to the door hardware whenever possible. The Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements. Motion based Request to Exit devices shall only be used when not available in the door hardware.

B. The motion based REX shall be a dual technology device with Passive Infrared (PIR) and Range-Controlled Radar (RCR) motion detector.

C. Reduces false alarms by sensing both heat and physical motion.

D. Independent adjustable beam pattern and radar depth.

E. Provide with mounting plate or wall mounting plate to mount over a single-gang backbox when required.

F. Provide color that matches door as close as possible.

G. DPDT output.

H. DC Power draw: 28mA max @ 12 VDC, 17mA max @ 24 VDC.

I. AC Power draw: 38mA max @ 12 VAC, 29mA max @ 24 VAC.

J. Dimensions: 1.76”H x 7.395”W x 1.85”D.

K. Utilize contact closure REX hardware built into the handle or crashbar whenever possible.

2.12 ELECTRIFIED HARDWARE (EH)

A. The Security Contractor shall be responsible for the connection of all new electrified hardware to the access control system. This shall include providing centralized power supplies located next to or integral to the access control panels. The Contractor shall coordinate with the door hardware specifications and schedules for additional information.

PART 3 - EXECUTION

3.1 INSTALLATION

A. ACAMS Client Software
   1. Only reader license software is to be furnished for this section of the project.

B. ACAMS Control Panels
   1. Place power supply and associated hardware in same location.
   2. Provide designated resistors at device end of line per manufacturer’s EOL recommendation to provide four-state supervision of security device and cabling.
   3. Provide EOL supervision for alarm contacts, local alarm sounders, motion detectors, glass break detectors, help/duress buttons, and other designated security devices connected to the ACAMS and IDS.
   4. Provide the following states of supervision:
      a. Contact closed = Secure
      b. Contact open = Alarm
      c. Short circuit = Line fault
      d. Open circuit = Line fault

C. Card Readers

1. Wire the card reader's multi-color LED to indicate the following status of the door.
    a. Red status indicates the door is secure (locked).
    b. Green status indicates the door is unsecured (unlocked).
2. The card reader to produce an audible beep tone to indicate to the user:
    a. The card was read and/or access was denied.
    b. Door is being held open and needs to be closed.

D. D. Door Hardware
1. Route power to electrically controlled locks on life-safety doors through fire alarm output to automatically unlock the door upon activation of Fire/Life-Safety system. Connect fire alarm output to the disconnect relay on the associated 24VDC lock power supply.
2. Setup and conduct a door hardware coordination meeting.
3. Coordinate the installation and termination of the security cable with the installation of the electric door hardware and transfer hinge.
4. Provide cable and terminate wires to delayed egress devices for monitoring activation of delayed egress by the ACAMS system.

E. Door Contacts (Installed on all exterior doors and card reader doors)
1. Install on protected (secured) side of door.
2. Install 6" from leading edge at top of door.

3.2 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner's IT and Security representatives to determine the programming criteria. Discuss the following:
1. Access card levels and door groupings
2. Alarm priority levels
3. Schedules and time codes
4. Holidays and holiday types (priorities)
5. Action/responses from individual input points
6. Standard and custom (expanded) reports
7. Defining alarm messages and standard response messages applicable to site
8. Routing of alarm points to selected mobile phones
9. Routing of alarm points to operator's workstations, printers, and history files
10. Coordinate implementation of graphics with Owner. Clean up (remove grid lines, sheet notes, clouds, etc) CAD drawing backgrounds for use as graphic maps clearly showing security devices. Develop sample graphic complete with icons and text. Alarms to appear on building floor plans depicting the nature and location of alarms. Review and revise graphic layout as required by Owner.

B. Develop CAD drawing files of floor plans and perform the following relative to system graphics:
1. Delete non-applicable drawing layers and details to arrive at simple floor plans of the building as built.
2. Convert drawings to a graphic file format compatible with the Owner's access control and alarm monitoring system.
3. Load drawing files into the system.

4. Apply new and predefined icons and other points on each graphic to indicate point and control status.
5. Link graphic images to reader, monitor and control points.

3.3 TESTING

A. Commission ACAMS in accordance with Section 28 08 00.

END OF SECTION 28 1300

SECTION 31 01 90
Topsoil

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION includes requirements for topsoil in support of turf establishment.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.03 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures.
B. Imported topsoil Submittals shall include: Submit (2) copies of the load/delivery ticket showing:

1. Quantity of material.
2. Origin or location of the soil yard including physical address, contact information for the soil yard operator.
3. The date the material was ordered and delivered or picked up.
4. Submit a report including the topsoil analysis and recommendations for any fertilizer and/or soil amendments from a certified soil testing laboratory for approval. Analysis shall include: The laboratory report will be based on the following information:
5. type of vegetation to be grown, ie: Bermuda grass
6. if the site will be irrigated, ie: Typically Not
7. if the source site was previously fertilized Routine Analysis (Macronutrients) - N, P, K, Ca, Mg, Na, pH and conductivity (Ec). Micronutrients - S, Zn, Fe, Cu, B, Mo and Mn.
8. Organic matter.
9. Textural analysis.
10. Imported topsoil samples.

C. When requested by the Engineer, submit sufficient samples of topsoil for additional testing by the Owner. When additional samples are required, submit samples at least 60 days prior to delivery or placement of topsoil. Supply samples from the same source and stockpile as the topsoil for the project.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Import topsoil or provide topsoil generated on-site. Topsoil shall be easily cultivated, free from objectionable material including, gravel, large roots, stumps, wood, brush, debris, hard clods, clay balls, hardpan, refuse or other deleterious materials and be of reasonably uniform quality. In the case of on-site or nearby source, topsoil is the surface layer of material containing decaying vegetable matter and fine hair-like roots.

PART 3 - EXECUTION

3.01 TOPSOIL DELIVERY, STORAGE AND HANDLING

A. Deliver, stockpile and handle topsoil in such a way as to not contaminate the material with other soils or objectionable materials. Do not cast or place material, either temporarily or permanently, on top of bank without approval from the Engineer.

3.02 TOPSOIL GENERATED ON-SITE

A. Stripped topsoil generated on-site shall include fine roots and herbaceous vegetation as specified on the Plans or as directed by the Engineer. Stockpile topsoil generated on-site for use on the side slopes, berms, dry bottoms, wetland shelves and any other area directed by the Engineer.

3.03 TOPSOIL PLACEMENT

A. Prior to placing topsoil, disk or harrow the subgrade to a minimum depth of 4 inches until it is loose and uncompacted. Place top elevation of topsoil at the design finish grade elevation shown on the Plans. Do not spread topsoil when it is excessively wet or dry.

3.04 DISPOSAL

A. Refer to Section 02 41 13 - Material Disposal.

END OF SECTION

SECTION 31 10 00

Site Clearing

PART 1 - GENERAL

1.01 SECTION INCLUDES:

Work includes furnishing all labor and equipment necessary to clear the site and dispose of materials off-site, complete, including removing surface debris, removing all exotic vegetation, removing existing concrete slabs and structure, and excavating topsoil.

1.02 REGULATORY REQUIREMENTS:

A. Conform to applicable code for disposal of debris.

B. Coordinate clearing Work with Owner's representatives.

C. Remove all exotic vegetation in accordance with local, state, and Federal regulations.

D. Protect wetland areas and maintain required wetland setbacks in accordance with local, state, and Federal regulations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROTECTION:

A. Locate, identify, and protect utilities that remain, from damage.

B. Protect bench marks and existing structures, not designated to be removed, from damage or displacement.

3.02 REMOVAL:

A. Remove debris, rock, and extracted plant life from site. Legally dispose of debris off-site. Costs for removal are to be paid by Contractor.

3.03 SURVEY AND BARRICADING REQUIREMENTS:

A. Wetland Areas shall be surveyed and staked based on the approved site plan. No plant material shall be removed from wetland areas to facilitate surveying or soil boring sampling.

B. Prior to clearing, the Contractor shall ensure that wetland areas are barricaded. Wetland areas shall be protected with physical barriers during all clearing and construction activities in accordance with the following guidelines:

1. All Wetland Areas must be barricaded from the work area prior to any clearing of any part of the site or phase.
2. Barricades must be high-visibility orange safety fence (recommended) with a final height of at least 4 feet above the ground and not attached to vegetation
3. All barricades must be upright and maintained intact for the duration of construction.
4. Where areas are proposed for clearing (i.e. tank structures, utilities, drainage, paving, slabs etc.) the barricades must be offset at least 10 feet outside the Wetland Area or placed at the dripline of the canopy trees, whichever is greater.
5. All native vegetation which is not located in areas requiring their removal as part of the development plans shall be retained in their undisturbed state.

C. Barricades shall be maintained in good order and condition through construction of the project or phase. Cut of fill must meet existing grade without encroaching into Wetland Areas. Barricades shall not be removed until after the project or phase has been completed, inspected and approved.

3.04 PROHIBITED ACTIVITIES:

Prohibited activities in the wetland areas or easements within wetland areas include, but are not limited to: construction or placing of building materials on or above the ground; dumping or placing soil or other substances such as garbage, trash, and cuttings; removal or destruction of native trees, shrubs or other native vegetation; excavation, dredging or removal or soil materials; diking or fencing; vehicular traffic including recreational vehicle and off road vehicle use; permanent irrigation, trimming, pruning, or fertilization; and any other activities detrimental to drainage, flood control, water conservation, erosion control or fish and wildlife conservation and preservation.

3.05 EXOTIC VEGETATION REMOVAL:

A. Exotic Vegetation is a plant species designated as a Category I or II as defined by the most current List of Florida's Most Invasive Species by the Exotic Pest Plant Council.

Exotic Vegetation in adjacent wetland areas shall be removed by the least ecologically damaging method available. Such methods include hand pulling, hand spading, chain saw and/or treatment with an appropriate herbicide. No debris such as plant clippings or wood scraps shall be allowed in the wetland areas.

B. Contractor shall retain an environmental consultant or contractor to properly identify between native and exotic vegetation.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 31 23 16

UNCLASSIFIED EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavation for general site grading, street grading, and channel excavation.

B. Deviations from this City of Denton Standard Specification:
   1. None.

C. Related Specification Sections include but are not limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02 41 13 – Selective Site Demolition.
   4. Section 02 41 15 – Paving Removal.
   5. Section 31 00 00 – Site Clearing.
   6. Section 31 24 00 – Embankments.
   7. Section 31 25 14 – Erosion and Sedimentation Controls.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.3 REFERENCES

A. Abbreviations and Acronyms
   1. ROW: Right-of-Way
   2. SWPPP: Storm Water Pollution Prevention Plan

B. Classification:
   1. All authorized excavation is considered unclassified and involves removal of all materials necessary to complete excavation of the site. Any reference to rock, limestone, or other material on the Drawings and/or this specification is solely for the City and the Contractor’s information and is not to be taken as an indication or guarantee of classification of excavation. Payment will not be separated based on classification of excavation unless expressly noted in the Drawings.

C. Reference Standards
   1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.

a. Occupational Safety and Health Administration (OSHA):
   1) Technical Manual Section 5.
   2) Laws and Regulations Standard 1926, Safety and Health Regulations for Construction.
b. City of Denton Development Code

1.4 ADMINISTRATIVE REQUIREMENTS

A. Permits
   1. For commercial and residential construction, a Clear and Grade Permit is required.
      a. No excavation or embankment activities will be allowed without an executed construction contract and an assigned City inspector.
      b. If the City determines or suspects excavation and/or embankment activities have occurred prior to an executed contract and a City inspector assigned, all construction activities could be suspended for at least 30 days pending the results of the Pre-Earthwork meeting.
      c. Any damages caused by early clearing and grading activities will be repaired at no cost to the City.

B. Sequencing
   1. Sidewalk Construction
      a. Where existing sidewalks are to be closed during Paving Removal activities:
         1) Utilize pedestrian/sidewalk detour route specified in the Drawings
            a) If no detour route is provided, submit a pedestrian/sidewalk detour route to City for review.
      b. The pedestrian/sidewalk detour route will be subsidiary to pertinent Traffic Control items included with the project.
      c. Install all sidewalk detours and closures in accordance with the TMUTCD, State, and local guidelines.
      d. Provide any traffic control devices in accordance with Section 34 71 13.

C. Pre-Earthwork Meeting
   1. Hold a Pre-Earthwork meeting at the same time as the Pre-Site Clearing Meeting. Invite the City and appropriate representatives.
   2. Clearly mark all the following items prior to the meeting:
      a. All requirements for pre-site clearing meeting in accordance with 31 00 00.
      b. Excavation limits
      c. Cut/fill stakes
   3. Submit means and methods for any rock cutting for review prior to the Pre-Earthwork Meeting.
   4. Have the SWPPP in place and inspected by Watershed Protection in accordance with Section 01 57 13 prior to excavation activities.
   5. Determine any site-specific constraints or concerns prior to meeting for review.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Informational Submittal
   1. Equipment Information
      a. Submittal for all major equipment to include:
         1) Equipment name
         2) Size
         3) Intended use
   2. Explosives, Blasting, and Rock Ripping
      a. Submit storage locations and guidelines for using explosives.
      b. For rock ripping and blasting, submit means and methods prior to Pre-Earthwork meeting for review.
      c. Provide a list of personnel and employer who will be handling and using explosives. Provide reference information including previous projects and certifications proving explosive qualifications.

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE

A. Excavation Safety
   1. Perform all excavations in a safe manner.
   2. Comply with the requirements of OSHA 29 CFR part 1926 and state requirements when performing excavation, sheeting, and bracing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements
   1. Secure and maintain a location to store the material prior to any excavation activities beginning in accordance with Section 01 66 00.
   2. Store excavated material to be used in other areas within the right-of-way (ROW) or easement limits unless specifically disallowed in the Contract Documents.
      a. If the Contract Documents do not allow the storage of excavated materials within ROW or easements, secure and maintain an adequate storage location off-site.
   3. Store material and equipment in approved areas that are at least 30 feet from edge of road limits. Install erosion control fencing around staging areas.
   4. For urban areas with limited staging areas, designate offsite location for storing and staging of materials and equipment. If this is not feasible, obtain approval from the City to stage and store materials within project site.
   5. All offsite staging areas to be in accordance with SWPPP and Watershed Protection requirements. Offsite staging areas are considered part of the project site and will need to be included with the SWPPP and Watershed Protection review.
   6. If excavated material is stored off-site:
      a. Provide an authorized letter from property owner approving the storage of excavated materials.

b. Contractor is responsible for negotiating and coordinating with the property owner.
c. The City is not responsible for establishing an off-site location.
d. The City is not liable for any damage resulting in off-site storage of excavated materials.

7. Remove any excavated material not used in other areas within 48 hours of excavation activities.
8. Do not block drainage ways, inlets, or driveways with excavation activities or materials.
9. Provide erosion control in accordance with Section 31 25 14.
10. Store materials only in areas barricaded as provided in the traffic control plans or as approved by the City if excavation is performed during active traffic.
11. Do not store material within the drip line of any tree or in landscaped areas.
12. Install tree protection in accordance with Section 31 10 00.

1.11 FIELD CONDITIONS

A. Existing Conditions
1. Any data provided regarding subsurface conditions of excavated material is not intended as a representation or warranty of accuracy or continuity of proposed excavated material.
2. The City is not responsible for interpretations or conclusions made by the Contractor regarding the existing material to be excavated.

PART 2 - PRODUCTS [NOT USED]

2.1 NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation
1. If needed, provide temporary drainage to maintain positive drainage throughout excavation activities. Any temporary drainage construction will be considered subsidiary to excavation.
2. Dewatering and temporary storm drain activities will be considered part of the SWPPP and Watershed Protection review and are required to be in accordance with all requirements listed therein.

B. Demolition / Removal
1. Remove any existing pavement in accordance with Section 02 41 15 and 02 41 13.

3.2 EXCAVATION

A. General
1. Accept ownership of unsuitable or excess material and dispose of material off-site in accordance with Federal, State, and local regulations. City is not responsible for any disposed material or disposal activities.

2. Perform excavations while material to be excavated is dry aside from water applied for dust control.
3. Contractor is responsible for the condition of the subgrade until the pavement is in place.
4. Over-excavate and replace any portion of subgrade that becomes damaged or unstable due to weather or construction activities prior to stabilizing the subgrade, installing base material, or placing the pavement. This will be at no cost to the City.
5. Separate, remove, and dispose of unacceptable fill material as defined in Section 31 24 00 in accordance with Federal, State, and local regulations.
6. Maintain positive drainage in the excavated area to avoid damage to any existing structures, proposed structures, and the roadway.
7. Shape slopes to avoid loosening material below or outside the proposed grade.
8. Remove and dispose of slides as directed.

B. Earth Cut
   1. Excavate to finish grade or subgrade within acceptable subgrade tolerances.
   2. Use approved embankment material compacted in accordance with 31 24 00 to replace over-excavated material at no cost to City. Anticipated reasons for over excavation can include, but are not limited to:
      a. Excavation below an acceptable subgrade tolerance
      b. Soils damaged due to weather or construction activities
   3. Shape and compact subgrade in accordance with Section 31 24 00.
   4. Subgrade Tolerances
      a. Excavate to within 0.1 foot in all directions.
      b. In areas of over excavation, provide fill material approved by the City at no cost to City.

C. Rock Cut
   1. Do not use dynamite or rock ripping within 500 feet of residences or commercial development.
   2. Blasting
      a. Obtain City approval prior to any blasting.
      b. Send notification at least 15 days in advance to all property owners within 1,000 feet of the blasting site.
      c. Follow all OSHA regulations for explosives and blasting agents, including but not limited to requirements in the OSHA Technical Manual Section 5, and OSHA Laws and Regulations Standard 1926, Safety and Health Regulations for Constructions.
      d. Use only authorized workers with training, knowledge, or experience in the field of transporting, storing, handling, and use of explosives.
         1) Authorized workers also need to have working knowledge of State and local laws and regulations pertaining to explosives.
      e. If there are concerns that seismic vibrations may cause damage to adjacent structures, provide:
         1) A structural engineer to determine safe limits to prevent any damage.
         2) All equipment, monitors, tools, and engineering design necessary at no cost to the City.

f. Use blasting mats or other approved containment equipment to ensure that no rocks or debris will be thrown into the air.
g. Comply with all City of Denton noise ordinances when blasting.

3. Excavate to finish grade or subgrade within acceptable subgrade tolerances.
4. For small pockets or thin layers, remove rock to at least 12-inches below subgrade.
5. Use approved embankment material compacted in accordance with 31 24 00 to replace over excavated material at no cost to City.

D. Water for Construction

1. Provide water as needed for site preparation, compaction, dust control, and other incidental activities in accordance with local requirements in accordance with Section 01 35 13.

E. Dewatering

1. Dewatering is subsidiary to excavation and includes the installation and operation of all pumping, bailing, well-pointing, sumps, and draining necessary to keep the excavation free from groundwater, seepage water, water from storm drains, wastewater collection systems, ditches, creeks, ponds, and other sources.
2. Keep channels, trenches, pits, and other low point excavations drained as much as practical during construction at no cost to the City.
3. Construction will not be permitted in standing water.
4. Conform all discharge from dewatering activities to Federal, State, and local requirements in a manner approved by the City.
5. Control outlet velocities from dewatering discharges to prevent erosion.

F. Excavated Material

1. Maintain safe and convenient access to private and public properties adjacent to excavation activities unless specified in the Drawings. Obtain approval from the City for maintenance of access methods.
2. Acceptable fill material may be used for embankment in accordance with 31 24 00.
3. Stockpile acceptable excavated materials on-site in accordance with Sections 31 10 00 and 31 24 00. Proper erosion control and BMPs to be utilized in accordance with the Drawings, local guidelines, and approved by the City.

G. Methods of Excavation

1. Submit means and methods for review by the City prior for any method of excavation that is not using traditional excavation methods.
2. Comply with all Federal, State, and local regulations when developing and submitting for approval any alternative method.
3. If an alternative method is requested and approved after contract execution, perform excavation at no additional cost to the City beyond the stated excavation unit price in the bid form.

3.3 REPAIR

A. Repair the following at no cost to the City if any damage is caused due to excavation activities:

1. Adjacent concrete or asphalt pavement to remain
2. Adjacent sidewalk to remain
3. Adjacent curb or curb and gutter to remain
4. Adjacent subgrade or base material to remain
5. Utility piping, structures, and appurtenances
6. Irrigation systems including but not limited to sprinkler heads, conduit, and pipe.
7. Landscape beds or planters
8. Decorative hardscape or landscape features
9. Retaining walls

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 31 23 33
Excavating and Backfilling

PART 1 - GENERAL

1.01 DESCRIPTION

A. SECTION includes requirements for removing, stockpiling and replacing on-site vegetation and topsoil, excavating, repairing slopes, backfilling, grading the berms, backslope swales and related work.
B. This Section does not include excavating and backfilling for structures.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.
B. No payment will be made for over-excavation or over-filling beyond the design cross-sections, except as directed by the Engineer.

1.03 REFERENCES

A. ASTM D 698

1.04 DEFINITIONS

A. Existing Cross-Sections or Survey Data: Information obtained by design engineer to prepare Plans and bid documents.
B. Pre-Construction Cross-Sections or Survey Data: Information obtained by Contractor prior to construction to establish pre-construction conditions.
C. Contractor may accept existing cross-sections as pre-construction cross- SECTIONs.
D. Intermediate Cross-Sections or Survey Data: Information obtained by Contractor to establish extent of work, such as to remove disturbed soil and to repair slope failures, and/or periodic surveys completed prior to Final Cross-Sections.
E. Final Cross-Sections or Survey Data: Information obtained by Contractor at completion of excavation and/or fill.
F. Design Cross-Section or Survey Data: Proposed channel section shown on Plans showing final grades.

1.05 SUBMITTALS

A. Refer to Section 01 33 00 Submittal Procedures.
B. Submit written acceptance of Existing Cross-Sections or Survey Data, or submit Pre-Construction Cross-Sections or Survey Data for review and approval by the Engineer prior to the start of any excavation activities on site.
C. Submit plotted cross-sections and earthwork quantity calculations in tabular form.
D. For electronic survey data submittals, include all electronic files and report data used to calculate final quantities.

E. Survey information submittal shall include at a minimum: plan view showing points taken with elevations, 1-ft contour lines, and baseline corresponding with the design plan benchmark information, north arrow and scale.

1.06 CONSTRUCTION TESTS AND INSPECTION

A. Refer to Section 01 33 20 Construction Tests and Inspection.

PART 2 - PRODUCTS

2.01 FILL MATERIAL

A. Refer to Section 31 23 23 Fill Material.

PART 3 - EXECUTION

3.01 SITE PREPARATION

A. Prepare the site for construction in accordance with Section 31 11 00 Site Preparation and Restoration and Section 31 11 00 Clearing and Grubbing.
B. Remove grass and other vegetative cover from areas to be excavated or filled.
C. Remove material that may interfere with the proposed work, including unusable materials, disturbed soils and/or objectionable material as directed by Engineer.
D. Engineer will inspect and approve foundation soil prior to placement of fill.

3.02 TOPSOIL

A. Refer to Section 31 01 90 Topsoil.

3.03 CARE AND CONTROL OF WATER

A. Refer to Section 02 08 02 Care and Control of Water.

3.04 CONSTRUCTION

A. Construct to lines, grades and dimensions shown on the Plans.
B. Return over-excavation beyond the specified limits to grade at no cost to the Owner in accordance with Paragraph 3.05 of this Section.
C. Do not cast or place material, either temporarily or permanently, on top of bank without approval of Engineer.
D. Do not cut temporary shelves into side slopes without approval of Engineer.
E. Correct grading resulting in standing water at no cost to the Owner.
F. Grade side slopes as required by the Engineer to smoothly transition the lateral into the main channel at locations where lateral ditches enter the channel.

3.05 FILL

A. Level soil surface prior to placing first layer of fill.
B. Compaction of foundation soil surface shall be considered satisfactory when the Contractor is capable of achieving specified compaction for the first layer of fill.
C. Protect foundation soils and/or fill soils from detrimental drying.
D. Scarify surfaces to receive fill to ensure proper bonding.

E. When the surface can be penetrated by tamping roller feet, additional scarification is usually not necessary.
F. In areas that are shown to receive fill material, cut into existing (undisturbed) shall form a horizontal surface and corresponding nearly vertical surface.
G. The height difference between adjacent horizontal surfaces shall be a minimum of 3 feet.
H. Mechanically compact backfill provided under Section 31 23 23 Fill Material in 8-inch maximum layers, loose measure, to not less than 95 percent of maximum standard dry density (ASTM D 698) within plus or minus 3 percent of optimum moisture content.
I. Where approved for use by the Engineer, fat clay (CH) soil shall be mechanically compacted to not less than 95 percent or more than 98 percent of maximum standard dry density (ASTM D 698) at or within plus 3 percent of optimum moisture content.
J. Refer to Section 31 23 34 Structural Excavating and Backfilling for backfilling behind retaining structures, unless shown otherwise on the Plans.

3.06 BACKSLOPE DRAINAGE SYSTEMS

A. Backslope swale and interceptor structure elevations and locations shown on the Plans are approximate.
B. Final elevations and locations shall be field verified by the Engineer prior to installation.
C. Minor changes in location and grade shall be considered incidental and no extra payment will be made for such adjustments.

3.07 MAINTENANCE OF DRAINAGE

A. Maintain constant flow and drainage in the main and lateral channels, backslope swales and off-site swales.

3.08 EROSION AND SEDIMENT CONTROL

A. Use means, methods, sequences and scheduling to minimize erosion and sedimentation and other damage to the project site and facilities, including the following: Limit work in this Section to no more than 1,500 feet of channel at any time unless approved by the engineer.
B. Construct backslope drainage system, silt fences and vegetate each reach of the channel as soon as practical.
C. Refer to Section 32 92 00 Silt Fences and Section 32 92 00 Turf Establishment.
D. Failure to construct erosion control facilities in a timely manner may result in a directive to do so.
E. Engineer may stop construction on the project if, in the opinion of the Engineer, conditions warrant such action.
F. Remove sediment and debris prior to final acceptance of the Work by the Engineer at no additional cost to the Owner.
G. The removal of sediment includes reaches of channel downstream of the project where sedimentation occurred due to construction of this Project.

H. Comply with terms and conditions of the Texas Pollutant Discharge Elimination System (TPDES) permit, the Stormwater Pollution Prevention Plan (SWPPP) and Best Management Practices (BMPs) for this Project, if applicable.

3.09 MATERIAL DISPOSAL

A. Refer to Section 02 41 13 Material Disposal.

END OF SECTION

SECTION 31 25 03
Stabilized Construction Access

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION includes requirements for construction, maintenance and removal of stabilized construction access.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.03 SUBMITTALS

A. Refer to Section 01 33 00 - Submittals.
B. Refer to Section 31 05 19 - Geotextiles for Erosion Control Systems.
C. Submit gradation for 3 inch to 5 inch granular fill.
D. Refer to Section 31 37 00 - Riprap and Granular Fill.

PART 2 - PRODUCTS

2.01 GEOTEXTILE SEPARATION FABRIC

A. Provide a geotextile of woven or spunbond nonwoven fibers consisting of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins.
B. Provide geotextile fabric equal to the following average roll values or as directed by the Engineer: Minimum average roll value.

1. Elongation<50 percent.
2. Grab Strength200 pounds.
3. Puncture Strength75 pounds.
4. UV Stability (retained strength) 50 percent after 500 hours of exposure.

C. Maximum average roll value.
D. Apparent Opening Size (AOS) - 0.212 to 0.6 mm (#70 to #30 US sieve).

2.02 GRANULAR FILL

A. Refer to Section 31 37 00 - Riprap and Granular Fill.

PART 3 - EXECUTION

3.01 GENERAL

A. Provide stabilized access, washing areas and parking areas at locations shown on the Plans or as approved by the Engineer.
B. Furnish and place geotextile fabric as a permeable separator to prevent mixing of granular fill with underlying soil.

C. Place 3 inch to 5 inch granular fill to dimensions and depths shown on the Plans, or as directed by the Engineer.
D. The minimum thickness shall be 8 inches.
E. Granular Fill being reused shall be free of sediment, and meet the requirements of Specification 31 37 00 - Riprap and Granular Fill.
F. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas.
G. Use sandbags, gravel, boards or similar methods to prevent sediment from entering public rights-of-way, storm drains, ditches and watercourses.

3.02 MAINTENANCE

A. Inspect and maintain stabilized areas daily.
B. Provide periodic top dressing with additional granular fill as necessary.
C. Repair or replace components of stabilized access areas that become defective from intended use.
D. Maintain stabilized access areas until acceptance of the Project or as directed by Engineer.
E. Remove stabilized access promptly when directed by Engineer.
F. Restore areas where stabilized construction access was removed to final project grade in preparation of turf establishment by others.

3.03 DISPOSAL

A. Refer to Section 02 41 13 - Material Disposal.

END OF SECTION

SECTION 31 25 14

EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Installation and maintenance of temporary control measures necessary to prevent and control soil erosion, sedimentation, and water pollution.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
   2. Texas Department of Transportation, Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (TxDOT):
      a. Item 169, Soil Retention Blankets.
   3. Texas Department of Transportation (TxDOT), Departmental Material Specifications (DMS):
      a. DMS-6200, Filter Fabric.
      b. DMS-6230, Temporary Sediment Control Fence Fabric.
      c. DMS-6370, Erosion Control Blankets.
   4. NPDES and EPA

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sequencing
   1. Ensure erosion control measures are fully installed prior to any earth disturbing activities begin.
   2. Contact Stormwater Coordinator for initial inspection prior to any earth disturbing activities.
   3. On phased projects, final stabilization shall be completed and Erosion and Sediment Control devices removed from each phase as construction is completed.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.
B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Storm Water Pollution Prevention Plan (SWPPP) submittals in accordance with Section 01 57 13.
B. Storm Water Quality Management Plan (SWQMP)
C. Product Data
   1. Provide product data from each manufacturer supplying Erosion and Sediment Control devices and accessories.
   2. Product data sheets for all products to include:
      a. Manufacturer name
      b. Date
      c. Material description

d. Point of delivery
e. Data and test results as specified in this Section
f. Manufacturer Recommended Storing Data, if applicable
g. Application Recommendations, if applicable

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements
1. Secure and maintain a location to store the material in accordance with Section 01 66 00.
2. Store all storm water pollution prevention materials in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 CITY-SUPPLIED PRODUCTS [NOT USED]

2.2 MATERIALS

A. Reinforced Silt Fence
1. Fabric
a. Minimum 36-inches tall.
b. Provide fabric in accordance with the following criteria:

Property	Test Method	Specification Limit
Tensile Strength	ASTM D4632	90-lbs
Puncture Rating	ASTM D4833	60-lbs
Mullen Burst Rating	ASTM D3796	280-psi
Apparent Opening Size	ASTM D4751	Sieve No. 30 to No. 100
Ultraviolet Resistance	ASTM D4355	70 percent min

2. Posts
a. Provide steel T-section or L-section posts, 1.3 pounds per linear foot, and 4 feet in length minimum.
b. Provide plastic caps on all steel posts in areas exposed to pedestrian traffic.
c. Wood posts may be approved by City if project duration is expected to be less than 90 days.
3. Net Reinforcement
a. Provide net reinforcement of at least 12 gauge galvanized welded wire mesh, with a maximum opening size of 2x2 inches.
4. Stone Overflows
a. Provide 1 1/2 inch washed stone aggregate in accordance with Section 32 05 16.

B. Rock Filter Dam
1. Aggregate
a. Provide 3 to 6 inch aggregate in accordance with Section 32 05 16 for rock filter dam heights of 24 inches or less.
b. Provide 4 to 8 inch aggregate in accordance with Section 32 05 16 for rock filter dam heights greater than 24 inches in height.
2. Wire
a. If required, provide mesh consisting of minimum 20 gauge galvanized wire.
3. Fabric
a. For rock filter dams greater than 18 inches in height, provide filter fabric in accordance with the following criteria:

Property	Test Method	Specification Limit
Tensile Strength	ASTM D4632	250-lbs
Puncture Rating	ASTM D4833	135-lbs
Mullen Burst Rating	ASTM D3796	420-psi
Apparent Opening Size	ASTM D4751	Sieve No. 20 max
Ultraviolet Resistance	ASTM D4355	20 percent min

C. Organic Filter Tube
   1. Containment Mesh
      a. Provide biodegradable, photodegradable, or recyclable containment mesh with a minimum rated life of one year under normal site conditions, such as burlap, twine, UV photodegradable plastic, or polyester.
         1) Obtain approval from the City for use of any other material.
      b. Provide recyclable containment mesh for temporary organic filter tube installation.
      c. Provide biodegradable or photodegradable containment mesh when organic filter tube will remain in place as part of vegetative system.
   2. Core Material
      a. Provide biodegradable or recyclable core material such as compost, mulch, or coir.
         1) Obtain approval from the City for use of any other material.
   3. Posts
      a. Provide steel T-section or L-section posts, 1.3 pounds per linear foot or 2 inches by 2 inches wooden posts.
      b. Provide posts at least 6 inches longer than the outside diameter of the Organic Filter Tube.

D. Inlet Protection
   1. Provide Inlet Protection comprised of Organic Filter Tubes or rock bags for erosion control in accordance with this Section.

E. Erosion Control Blanket
   1. Blanket
      a. In accordance with DMS 6370.
   2. Staples
      a. In accordance with the Erosion Control Blanket manufacturer recommendations.

F. Stabilized Construction Exit
   1. Aggregate
      a. Provide 3 to 6 inch aggregate in accordance with Section 32 05 16.

G. Mulching
   1. Provide type of organic mulching as specified in the Drawings.

H. Pipe Inlet Sediment Trap
   1. Riprap
      a. Provide 6 to 12 inch Dry Stone Riprap in accordance with Section 31 37 00.
   2. Filter Stone
      a. Provide 1 1/2 inch washed stone aggregate in accordance with Section 32 05 16.
   3. Wire
      a. Provide mesh consisting of minimum 20 gauge galvanized wire with 1/2 inch by 1/2 inch openings.
   4. Fabric

a. Provide Filter Fabric meeting the following criteria:

Property	Test Method	Specification Limit
Tensile Strength	ASTM D4632	250-lbs
Puncture Rating	ASTM D4833	135-lbs
Mullen Burst Rating	ASTM D3796	420-psi
Apparent Opening Size	ASTM D4751	Sieve No. 20 max
Ultraviolet Resistance	ASTM D4355	20 percent min

5. Concrete Block
   a. Provide standard 8-inch x 8-inch x 16-inch concrete masonry units in accordance with ASTM C139.

I. Stone Outlet Sediment Trap
1. Riprap
   a. Provide 6 to 12 inch Dry Stone Riprap in accordance with Section 31 37 00.
2. Filter Stone
   a. Provide 1 1/2 inch washed stone aggregate in accordance with Section 32 05 16.
3. Fabric
   a. Provide Filter Fabric in accordance with the following criteria:

Property	Test Method	Specification Limit
Tensile Strength	ASTM D4632	250-lbs
Puncture Rating	ASTM D4833	135-lbs
Mullen Burst Rating	ASTM D3796	420-psi
Apparent Opening Size	ASTM D4751	Sieve No. 20 max
Ultraviolet Resistance	ASTM D4355	20 percent min

J. Turf Reinforcement Mat
1. Provide Turf Reinforcement Mats in accordance with TxDOT Item 169 Approved Products List, *Erosion Control Approved Products* and in accordance with the following criteria:

Property	Test Method	Specification Limit
Minimum Thickness	ASTM D6525	0.25 in
Ultraviolet Resistance	ASTM D4355	80 percent
Tensile Strength	ASTM D6818	175 lbs/ft

K. Dewatering Controls
1. Sediment Filter Bag
   a. Provide sediment filter bags made of non-woven, needle-punched, geotextile that meets the following criteria:

Property	Test Method	Specification Limit
Tensile Strength	ASTM D4632	250-lbs
Puncture Rating	ASTM D4833	135-lbs
Mullen Burst Rating	ASTM D3796	420-psi
Ultraviolet Resistance	ASTM D4355	20 percent min
Water Flow Rate	ASTM D4491	85 to 110 gpm/ft^2

2. Temporary Sediment Tank
    a. Provide compartmented container with a storage volume equal to 1 cubic foot for each gallon per minute of pump discharge capacity.

PART 3 - EXECUTION

3.1 PREPARATION

A. General
1. Remove trees, brush, stumps, and other objectionable material that will interfere with the construction of the erosion control measure.

B. Erosion Control Blanket
1. Remove rocks, dirt clods, stumps, and other objectionable material that will prevent the mat from lying in direct contact with the soil.

C. Mulching
1. Fertilize and treat soil prior to mulching installation when used with final vegetation.
    a. Fertilization and soil treatment are not required when using mulching with hydroseeding or when seed is spread during winter months.

D. Turf Reinforcement Mat
1. Remove rocks, dirt clods, stumps, and other objectionable material that will prevent the mat from lying in direct contact with the soil.

3.2 INSTALLATION

A. Reinforced Silt Fence
1. Provide silt fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow.
2. Install posts 18 inches deep, maximum 6 feet on center.
3. Dig 6-inch x 6-inch trench on uphill side of fence and embed fabric and wire mesh. Backfill the trench.
4. Attach wire mesh reinforcement to posts with clips for metal T-posts or staples for wood posts in at least four equally spaced locations per post.
5. Fasten fabric to top of net reinforcement at a maximum spacing of 15 inches.
6. Locate splices in fabric at a post and provide a 6-foot overlap ensuring no leakage or bypass.
7. Install stone overflow structures at low points or spaced at approximately 300 feet if there is no apparent low point.
8. Turn last 10 feet of Reinforced Silt Fence slightly uphill to prevent bypass.
9. Repair or replace any posts, net reinforcement, or fabric that are bent, torn, or otherwise unable to function as intended in accordance with this Section.

B. Rock Filter Dam
1. Place the aggregate to the lines, height, and slopes specified in the Drawings.
2. Place Rock Filter Dams perpendicular to the direction of flow.

C. Sediment Erosion Control Log
1. Install Sediment Erosion Control Log near the downstream perimeter of a disturbed area to intercept sediment from sheet flow.
2. When placed on soil, excavate a 1-inch to 2-inch deep bedding trench along the length of the Sediment Erosion Control Log.
3. Secure Sediment Erosion Control Log using 1½" x 1½" x 18" wooden stakes or 18" metal T-posts to prevent displacement as a result of normal rain events, damage to the logs, and flow from penetrating under the logs.
    a. Rock bags may be used in place of posts on paved surfaces.

4. Overlap ends of Organic Filter Tubes by at least 18 inches and secure ends together preventing gaps from forming.
5. Turn last 10 feet of Organic Filter Tubes slightly uphill to prevent bypass.

D. Inlet Protection
1. Install prefabricated inlet protection systems in accordance with manufacturer's instructions.
2. Install Organic Filter Tubes, rock bags, and filter fabric as specified in the Drawings and in accordance with this Section.
3. Install inlet protection systems to provide 2-inch overflow capability to allow storm water overflow during extreme storm events or when filter media on protection device clogs.

E. Erosion Control Blanket
1. Use an Erosion Control Blanket anywhere seeding is to be used and the slope is steeper than a 6:1 slope.
2. Use Turf Reinforcement Mat when stabilizing slopes of 3:1 or steeper.
3. Provide blanket on sod locations only when specified in the Drawings.
4. Dig 6 inch trench along the entire perimeter of the installation area.
5. Lay Erosion Control Blanket into trench and backfill with compacted soil.
6. Fasten Erosion Control Blanket in accordance with manufacturer's instructions.
7. Ensure staples are installed parallel to the direction of flow.
8. Overlap ends of Erosion Control Blanket by a minimum of 3 feet, and longitudinal edges by 6 inches.
9. Staple Erosion Control Blanket at all critical channel points and all overlaps.

F. Stabilized Construction Entrance/Exit
1. Install stabilized construction exit as specified in the Drawings.
2. Install stabilized construction exits at any point where traffic will be leaving a construction site to or from a street, alley, sidewalk, or parking area.
3. Slope stabilized construction exit away from offsite paved surfaces or incorporate a drainage swale to prevent runoff from leaving the construction site.
4. Do not place stabilized construction exits at the lowest point on the construction site or on top of utility lines.
5. Minimum width of 20 feet for residential and 30 feet for commercial.

G. Mulching
1. Spread organic mulch by hand or mechanical means providing complete, uniform coverage of the specified area.
2. Install mulching to a thickness between 1 to 2 inches.
3. Anchor mulching by application of fiber mulch binder, synthetic mulch binder, using a tractor-drawn crimper to punch into the soil, or by placing netting above the mulch and stapled into the ground when placed on slopes of 3:1 or steeper.
4. Do not use mulching on slopes of 1.5:1 or steeper.

H. Pipe Inlet Sediment Trap
1. Install pipe inlet sediment trap as specified in the Drawings.
2. Provide a stormwater and sediment storage area upslope of the pipe inlet sediment trap to a minimum volume equal to the runoff calculated from the temporary control design storm.
3. Provide side slopes surrounding the storage area at 3:1 or flatter.
4. Install the pipe inlet sediment trap to a maximum height of half the inlet pipe diameter.

5. Install pipe inlet sediment trap to provide 2-inch overflow capability to allow storm water overflow during extreme storm events or when filter media on protection device clogs.

I. Stone Outlet Sediment Trap
   1. Install stone outlet sediment trap as specified in the Drawings.
   2. Provide a stormwater and sediment storage area upslope of the pipe inlet sediment trap to a minimum volume equal to the runoff calculated from the temporary control design storm.
   3. Install the pipe inlet sediment trap to a maximum height of half the inlet pipe diameter.
   4. Grade side slopes surrounding the storage area at 3:1 or flatter.
   5. Install pipe inlet sediment trap to provide 2-inch overflow capability to allow storm water overflow during extreme storm events or when filter media on protection device clogs.

J. Turf Reinforcement Mat
   1. Install turf reinforcement mats as specified in the Drawings and manufacturer's recommendations.
   2. Install turf reinforcement mats immediately after completing grading of the slope or channel, and at most within 7 days after completing the grading.
   3. Install turf reinforcement mats vertically down slope on steep cut/fill slopes, embankments, and steep channel slopes above the water surface level.
   4. Install turf reinforcement mats horizontally (parallel to flow) for channel slopes below the water surface level.
   5. Dig 6 inch trench along the entire perimeter of the installation area.
   6. Lay turf reinforcement mat into trench and backfill with compacted soil.
   7. Fasten turf reinforcement mat in accordance with manufacturer's instructions.
   8. Ensure staples are installed parallel to the direction of flow.
   9. Overlap ends of turf reinforcement mat by a minimum of 3 feet, and longitudinal edges by 6 inches.
   10. Staple turf reinforcement mat at all critical channel points and all overlaps.

3.3 REPAIR

1. Repair any controls determined to no longer be functioning as intended in accordance with this Section.
2. Repair devices as soon as exposed ground has dried sufficiently to prevent further damage from equipment operations needed for repairs.

3.4 FIELD QUALITY CONTROL

A. Field Inspections
   1. Inspect all best management practices at least once every 7 calendar days with Stormwater Coordinator.
   2. Inspect dewatering pumps and sediment controls hourly while pumps are in operation.

3.5 MAINTENANCE

A. General
   1. If a storm water pollution prevention control ceases to function as intended, repair and replace the device or any portions necessary. Repeated failure indicates a device is insufficient and additional or different Erosion and Sediment Control devices must be selected.
   2. Remove sediment, debris, and litter from all devices as necessary to maintain intended operation.
   3. Continue maintenance of all erosion and sediment control devices until vegetative cover reaches 70 percent density, as determined by the City.

B. Rock Filter Dam
   1. Remove silt when it reaches a depth equal to one-third the height of the dam or one foot, whichever is less.

C. Dewatering Controls
   1. Repair areas eroded due to dewatering pumping and install erosion control devices to prevent further erosion.
   2. Clean sediment tanks when they become half full of sediment.

END OF SECTION

SECTION 31 30 00
Earthwork

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Sections in Division-1 of these Technical Specifications, apply to work specified in this section.

1.02 DESCRIPTION OF WORK:

A. Extent of earthwork is indicated on drawings and within this specification.

1. The Contractor will regrade areas of the site which his operations or the operations of his subcontractors have affected.

2. Preparation of subgrade for building slabs, walks, and pavement is included as part of this work.

B. Excavation for Mechanical/Electrical Work: Excavation and backfill required in conjunction with underground mechanical and electrical utilities and buried mechanical and electrical appurtenances is included as work of this section.

C. Definitions:

1. "Structural Excavation" will consist of removal of material encountered to the depths indicated herein and subsequent disposal of materials removed.

2. "Channel Excavation" will consist of required excavation for channels within the limits of the project, associated rights-of-way or designated easements; the removal and proper utilization or disposal of all excavated materials; and constructing, shaping, and finishing of all earthwork involved in conformity with the required lines, grades, and typical cross sections and in accordance with specification requirements herein outlined.

   All authorized channel excavation will be unclassified.

3. "Street Excavation" will consist of all the required excavation within the limits of the paving portions of the project, associated rights-of-way and areas adjacent thereto (except excavation specifically described and provided for elsewhere in the specifications); the removal, proper utilization, or disposal of all excavated material; and the scraping and finishing of all earthwork in conformity with the

lines and grades as shown on the plans or as established by the Engineer, all in accordance with the specification requirements contained herein.

Without regard to materials encountered, all street excavation shall be unclassified and shall be designated as "Street Excavation" which will include all materials excavated. It is to be distinctly understood that any reference to rock, or any other material on the plans, and/or in this specification is solely for general information, and is not to be taken as an indication of classification of excavation.

4. "Borrow" will consist of required excavation, removal, and proper utilization of materials obtained from designated or approved sources. Compaction of embankments constructed from borrow, as provided herein, shall conform to the requirements of this Section.

All authorized borrow will be unclassified.

5. "Embankment" will consist of the placement and compaction of all materials obtained from street excavation, borrow, or any other excavation.

6. "Backfill" and "Fill Materials" will consist of soil materials free of clay, rock or gravel larger than 2" in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

7. "Topsoil" will consist of furnishing and placing a minimum of six (6) inches of top soil, free from rock and foreign material, in all parkways, areas to be landscaped, and medians to the lines and grades as established by the Engineer.

8. "Structural Excavation" for miscellaneous structures shall consist of the removal of material for the construction of foundations for bridges, retaining walls, head walls for culverts, or other structures, and other excavation designated on the plans or in these specifications or in the Special Conditions as structural excavation, and the subsequent backfill of these same structures.

1.03 QUALITY ASSURANCE:

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1.04 SUBMITTALS:

A. Test Reports-Excavating: Submit the following reports directly to the Engineer from the testing services; with copy to Owner:

1. Field density test reports.

1.05 JOB CONDITIONS:

A. Site Information: Any data which has or may be provided on subsurface conditions is not intended as a representation or warranty of accuracy or continuity between soil strata. It is expressly understood that neither the Owner nor the Engineer will be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for convenience of Contractor.

1. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner, provided he obtains the Owner's permission prior to performing these operations.

B. Contractor is to verify existing site grading within 30 days of contract date. Discrepancies are to be brought to the Engineer's attention in writing during that period. Any and all site grading discrepancies found after that date will be the total responsibility of the general contractor.

C. Existing Utilities: Contractor shall locate all existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner, and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

2. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.

a. Provide minimum of 48-hour notice to Engineer, and receive written notice to proceed before interrupting any utility.

3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

4. Use of Explosives: The use of explosive is not permitted.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damages caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

a. Perform excavation by hand within drip-line of large trees to remain, and protect the root system from damage or drying out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.

PART 2 - PRODUCTS

2.01 SOILS MATERIALS:

A. Select fill, when properly slaked and tested by standard laboratory methods, shall meet the following requirements:

All select fill should consist of clayey sand (SC) having a liquid limit (LL) of less than 35 and a plasticity index (PI) of 16 or less. Place the select fill in maximum eight (8) inch lifts and compact with a moisture range of three (3) percent below to three (3) percent above the optimum moisture content to a minimum dry density of 100% of the Standard Proctor dry density (ASTM D698).

Locally available select fill materials often contain large clay lumps or sandstone fragments, Prior to compaction, the fill should contain no clay lumps or rock fragments having a maximum dimension in excess of five inches, If necessary, each lift may be pulverized using a travelling mixer to improve uniformity. Sampling for conformance with Atterberg limit specifications should be done such that samples representative of the aggregate fill are obtained.

B. When called for on the plans, special backfill material, such as pit run gravel, shall be placed at the locations and in the manner called for on the plans. All other backfill material shall be earth, free of any appreciable amount of stone or gravel particles more than two (2) inches in greatest dimension, large or frozen lumps, wood or other extraneous material, and shall be of such gradation as to permit thorough compaction.

PART 3 EXECUTION

3.01 STRUCTURAL EXCAVATION:

A. Excavation is unclassified, and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered. Structural excavation shall include the furnishing of all materials and equipment; the construction or installation of all cofferdams and other facilities which may be necessary to perform the excavations and place and compact the backfill; and the subsequent removal of such facilities, except where they are required or permitted by the plans or specifications to remain in place. The contractor shall follow the recommendations outlined in the Geotechnical Report in the Appendix for any structural excavations.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific approval or direction of the Engineer. Unauthorized excavation, as well as remedial work resulting from the unauthorized excavation, shall be at Contractor's expense.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Soil bearing shall be verified by the geotechnical engineer.

2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classifications, unless otherwise directed by the Engineer.

C. Additional Excavation:

1. When excavation has reached required subgrade elevations, notify the Engineer so that he may observe the conditions.

2. When unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by the Engineer.

3. When footing concrete or masonry is to rest upon rock, the rock shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled off or cut to approximate horizontal and vertical steps, and shall be roughened. Seams in the rock shall be grouted under pressure or treated as the Engineer may direct and the cost thereof will be included for payment in the quantities for the unit of the structure for which the excavation is made. When footing concrete or

masonry is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation and final removal of the foundation material to grade shall not be made until just before the concrete or masonry is placed. Except when over-excavation is directed by the Engineer, excavation below grade shall be replaced at the Contractor's expense with the same class of concrete specified for the structure and at the time the concrete for the structure is being placed.

4. For all single and multiple box culverts, pipe culverts, and pipe arch culverts, where the soil encountered at established footing grade is a quick sand, muck, or similar unstable material, the following procedure shall be used unless other methods are called for on the plans:

    a. All unstable soil shall be removed to a depth of two (2) feet below bottom of culvert for culverts two (2) feet to four (4) feet in height, and to a depth equal to the height of culvert for culverts less than two (2) feet in height. Such excavation shall be carried at least one (1) foot beyond the horizontal limits of the structure on all sides. The Engineer will determine the necessary over excavation for culverts larger than four (4) feet in height. All unstable soil so removed shall be replaced with suitable stable material, placed in uniform layers of suitable depth for compaction as directed by the Engineer, and each layer shall be wetted if necessary, and compacted by rolling or tamping as required to provide a stable foundation for the structure. Soil which is considered to be of sufficient stability to sustain properly the adjacent sections of the roadway embankment will be considered a suitable foundation material for the culvert.

    b. When the material encountered at footing grade of a culvert is found to be partially rock, or incompressible material, and partially a soil or material that is compressible, but otherwise satisfactory for the foundation, the incompressible material shall be removed for a depth of six (6) inches below the footing Grade and backfilled with a material similar to the compressible foundation used for the rest of the structure.

5. When the material encountered at footing grade of a bridge bent or pier is found to be partially of rock or incompressible material, and partially of a compressible material, the foundation shall not be placed until the Engineer has authorized such changes as are found necessary.

6. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

D. Shoring and Bracing: Comply fully with the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations pertaining to Excavations, Trenching, and Shoring (29 C.F.R. 1926.650 - 1926.653).

E. Dewatering:

1. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundation. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from and beneath excavations to a minimum depth of 3' below the bottom of excavation.

3. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

4. Cofferdams for foundation construction shall be carried well below the bottom of the footings and shall be well braced and reasonably watertight. The interior dimensions of cofferdams shall provide sufficient clearance inside the wales for constructing forms and driving piles and to permit pumping outside the forms.

5. If in the judgment of the Contractor, the clearance provided on the plans between the outside line of the footing and any pile or interior wall or surface is not sufficient to permit the driving of piles or building of forms, he may provide such necessary clearance by constructing the cofferdam sufficiently large to provide such clearance as he may deem necessary. Any such enlargement should not be in excess of one foot outside the dimensions of the footing as shown on the plans shall be considered as being for the sole purpose of expediting the work of the Contractor and such excavation and backfill shall be at the Contractor's expense.

6. Cofferdams which are tilted or moved out of position by any cause during the process of sinking shall be plumbed or enlarged so as to provide the necessary clearance and proper pier location and such work shall be at the Contractor's expense.

7. In tidal waters or in streams at a time of probable flood, cofferdam walls shall be vented at low water elevation to insure equal hydrostatic head both inside and outside of the cofferdam during the period of pouring and setting of seals.

8. No shoring will be permitted in cofferdams which will induce stress, shock, or vibration in the permanent structure.

9. When permitted by the Engineer, cross struts or bracing may extend through foundation concrete. Such struts or bracing below low water will be permitted to remain in place, except in navigable streams or, when specified in the Special Provisions or shown on the plans to be removed. Struts or bracing above low water shall be removed and the resulting space filled with concrete of the same mix as that specified for the surrounding concrete.

   For substructure work, the Contractor shall submit drawings showing his proposed method of cofferdam construction and other details left open to his choice or not fully shown on the plans. The type and clearance of cofferdams, insofar as such details affect the character of the finished work, will be subject to the approval of the Engineer, but other details of design will be left to the Contractor who will be responsible for the successful construction of the work. The drawings shall be submitted at least thirty (30) days in advance of the time the Contractor begins construction of the cofferdams.

   After completion of the substructure, the cofferdams with all sheeting and bracing shall be removed at least to two (2) feet below the level of the stream bed, by the Contractor at his expense, and such removal shall be performed in a manner that will not disturb or mar the finished concrete or masonry or violate any environmental constraints placed on the project.

F. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

Dispose of excess soil material and waste materials as specified herein.

G. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus 0.0', or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of service, other construction, and for inspection.

1. Concrete Slab on Grade: Remove the existing soils to a depth of 3 feet below the proposed finished floor elevation and within five feet horizontally of the slab or as specified on the plans.

3.02 CHANNEL EXCAVATION:

A. All suitable materials removed from the excavation shall be used, insofar as practicable for fill material or, in the formation of "Embankments", or shall be otherwise utilized or satisfactorily disposed of as indicated on the plans, or as directed. Completed work shall conform to the established alignment, grades, and cross-sections. During construction, the channel shall be kept drained, insofar as practicable, and the work shall be prosecuted in a neat workmanlike manner.

B. Unsuitable channel excavation and suitable channel excavation in excess of that needed for construction shall be known as "waste" and shall become the property of the Contractor to be disposed of by him outside the limits of the project, associated rights-of-way, etc.

C. Payment will not be allowed for excavation of any material which is used for purposes other than those designated, except as provided in the specifications.

3.03 STREET EXCAVATION:

A. All excavation shall be in accordance with the lines, grades, and typical sections as shown on the plans or as established by the Engineer. Unless otherwise shown on the plans or established by the Engineer, the street excavation will be made to the subgrade of the street or paving project and the finished grade of parkways.

1. Where excavation to grades established in the field would terminate in unstable soil, the Engineer may require the Contractor to remove the unstable soil and backfill to the required grade with suitable material compacted in an approved manner to the required density.

2. Where excavation to grade established in the field terminates in loose or solid rock, the Contractor may be required to extend the depth of excavation six (6) inches and backfill with select material compacted in an approved manner to the required density. Subject to the approval of the Engineer, the select material may be obtained from any point within the project limits where suitable backfill material is available.

3. The Contractor shall conduct his operation in such a manner that adequate measurements may be taken before any backfill, as required above, is placed.

B. Provisions for Drainage: If it is necessary in the prosecution of the work to interrupt the natural drainage of the surface, or the flow of artificial drains, the Contractor shall provide temporary drainage facilities that will prevent damage to public or private interests, and shall restore the original drains as soon as the work will permit. The Contractor shall be held liable for all damages which may result from neglect to provide for either natural or artificial drainage which his work may have interrupted.

C. Excess Excavation: Unsuitable street excavation and suitable street excavation in excess of that needed for construction shall be disposed of at the Contractor's expense as directed by the Engineer. In general, suitable excess excavation from paving projects will be used in the construction of parkways, widening of embankments, flattening of slopes, etc., but if necessary to waste any material, it shall be disposed of, at the Contractor's expense, in such a manner as to present a neat appearance and to not obstruct proper drainage or cause injury to any street improvements or abutting property.

3.04 BORROW EXCAVATION:

A. Construction Methods:

1. All suitable materials removed from the excavation shall be used, insofar as practicable, in the formation of "Embankments", or shall otherwise be utilized as indicated on the plans or as directed, and the completed work shall conform to the established alignment, grades, and cross-section. During construction, the borrow sources shall be kept drained, insofar as practicable, and the work shall be prosecuted in a neat and workmanlike manner.

2. Payment will not be allowed for excavation for any material which is used for purposes other than those designated, except as provided in the governing specifications.

3. The site of the borrow operations shall be left in a suitable and sightly condition, such as to provide proper drainage. Where indicated on the plans, the sides and/or ends of borrow pits shall be sloped to the dimensions indicated on the plans.

B. Selection of Materials: Where shown on the plans, selected materials will be utilized in the formation of backfill, embankment or to improve the paving sub-grades, in which case the work shall be performed in such manner and sequence that suitable material may be selected, removed separately, and deposited within the limits and at the elevations required. Acceptable borrow material when tested by standard laboratory methods shall meet the requirements indicated on the plans.

3.05 TOP SOIL:

A. Top soil will be secured from borrow sources as required to supplement material secured from other excavation. All excavated material which is suitable for top soil will be used in the parkways, medians and areas to be landscaped before any top soil is obtained from a borrow source. Top soil material secured from excavation shall be stockpiled at locations approved by the Engineer, and after completion of grading and paving operations, top soil shall be placed on parkways, medians and areas to be landscaped, so as to provide a minimum six (6) inch compacted depth of top soil.

3.06 COMPACTION (for Building Foundations and Building Appurtenances):

A. General: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture density relationship (cohesive soils) determined in accordance with ASTM D 1557; and not less than the following percentages of relative density, determined in accordance with ASTM D4253 and D4254, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

1. Concrete Slab on Grade: Remove the existing soils to a depth of 5.5 feet below the proposed finish floor elevation beneath and within five feet horizontally of concrete floor slabs on grade. Scarify and re-compact the upper 8" of remaining subgrade at or above optimum moisture content to between 93% and 98% of Standard Proctor Density (ASTM D-698). Proof roll the entire subgrade to locate any soft or yielding spots. If soft or unstable areas are located, remove, replace, and re-compact as necessary to obtain a firm unyielding subgrade. Replace the excavated soils up to 1 foot below final grade with site excavated or similar clay soils. Rock fragments larger than 4 inches should be processed and any deleterious materials discarded. The fill materials should be free of vegetation, debris, or otherwise deleterious materials. Compact in maximum 9-inch loose lifts at a minimum of 2 percentage points above optimum moisture to between 93% and 98% percent of Standard Proctor Density (ASTM D-698). Replace the final 1 foot of excavated soils up to the desired grade with select fill in loose lifts not more than 9" thick. Each lift shall be compacted to a minimum of 95% Standard Proctor Density with a moisture content (-2%)–(+3%) variance from the optimum moisture value. The select fill shall be placed within 48 hours of completing the installation of the moisture conditioned soils.

2. Exterior Slabs, Walks and Pavements: Remove organic material and scarify to 6" and compact to a minimum of 95% with a moisture content 4% above the optimum moisture value.

3. Lawn or Unpaved Areas: That portion of backfill which will not support any portion of the completed structures or embankment shall be placed in layers not more than ten (10) inches in depth and compacted to a density comparable with the adjacent, undisturbed material. The compacted layers of backfill shall be brought up uniformly on all sides of the structure.

4. That portion of backfill which will support any portion of the paving or embankment shall be placed in uniform layers not to exceed six (6) inches in depth (loose measurement) and compacted so that each layer and the completed backfill has a density of not less than ninety-five (95) percent of the maximum density as determined by ASTM Designation D-698.

C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

1. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until moisture content is reduced to a satisfactory value.

3.07 BACKFILL AND FILL:

A. General: Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.

1. In excavations, use satisfactory excavated or borrow material.

2. Under grassed areas, use satisfactory excavated or borrow material.

3. As soon as practicable all spaces excavated under this item and not occupied by the permanent structure shall be backfilled, except that no backfill shall be placed against any abutment or retaining wall until such structure has been in place at least seven (7) days. No backfill shall be placed adjacent to box culverts until the top slab has been in place at least four (4) days.

4. Under building slabs, use select fill material.

5. Care shall be taken to prevent any wedging action when placing backfill around abutments or wingwalls.

B. Backfill excavation as promptly as work permits, but not until completion of the following:

1. Completion of construction below finish grade including where applicable, damp-proofing, waterproofing, and perimeter insulation.

2. Inspection, testing, and recording locations of underground utilities.
3. Removal of concrete formwork.

4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

5. Removal of trash and debris.

6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

C. Ground Surface Preparation:

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

2. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break-up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

D. Placement and Compaction:

1. For areas other than those designated to receive paving, place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" loose depth for material by hand-operated tampers.

2. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

3. Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

3.08 GENERAL SITE GRADING:

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes, and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.

2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.0' above or 0.10' below required subgrade elevation.
3. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2" above or below required subgrade elevation.

D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.09 EMBANKMENT (For areas other than buildings or building appurtenances):

A. Construction Methods:

1. Prior to the placing of any embankment, all clearing and grubbing and site preparation shall have been completed. Stump holes or other small excavations within the limits of the embankment shall have been backfilled with suitable material and thoroughly tamped or compacted in an approved manner before

commencing the embankment construction. The surface of the ground, including plowed or loosened ground or small ditches or washes, shall be restored to approximately its original slope by blading or other methods, and shall be compacted by sprinkling and rolling.

2. The surface of hillsides shall be loosened by scarifying or plowing to a depth of not less than six (6) inches, or cut into steps before embankment materials are placed. The embankment shall then be placed in layers as hereinafter specified, beginning at the low side in part width layers and increasing the widths as the embankment is raised. The material which has been loosened shall be re-compacted simultaneously with embankment material placed at the same elevation.

3. Where embankment is to be placed over or adjacent to existing road beds, the slopes shall be plowed or scarified to a depth not less than six (6) inches and the embankment built up in successive layers, as herein specified, to the level of the old road bed before its height is increased, then the old road bed shall be scarified and re-compacted with the next layer of embankment. The total depth of the scarified and added materials shall not exceed the permissible depth of the layer.

4. Trees, stumps, roots, vegetation, or other unsuitable materials shall not be placed in the embankment.

5. All embankments shall be constructed in layers approximately parallel to the finished grade and shall be so constructed as nearly as possible to conform to the cross-section of the subgrade section.

6. Embankments shall be constructed to the established grade and to the shape of the typical section shown on the plans and each section shall conform to the detailed sections of slopes. After completion of the embankment, it shall be continuously maintained to its finished section and grade until the project is accepted.

B. Classification:

1. Earth embankments shall be composed principally of materials other than rock and shall be composed of acceptable materials. Embankments shall be constructed in successive layers, for the full width of specified depth or cross-sections, and in such lengths as are suitable for sprinkling and compaction methods to be used. Prior to compaction the layers shall not exceed six (6) inches in depth for pneumatic tire rolling or eight (8) inches in depth for rolling with other types of rollers. Layers of embankment may be formed by utilizing equipment which will spread the material as it is dumped, or they may be formed by being spread by blading or other acceptable methods from piles or windrows dumped

from excavating or hauling equipment in such amounts that the material is uniformly distributed.

2. Minor quantities of rock may be incorporated in the specified earth embankment layers, or may be placed in accordance with the requirements for construction of rock embankments in the deeper fills, provided such placement of rock is not immediately adjacent to any pipe or structure. Rock may also be placed in the portions of embankment outside the limits of a completed road bed width where the size of the rocks prohibits their incorporation in the normal earth embankment layers.

3. Each layer of earth embankment shall be uniform as to material, density, and moisture content before beginning compaction. Where layers of unlike material abut each other, each layer shall be featheredged, or the materials shall be so mixed as to prevent abrupt changes in the material. No materials placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position. All such piles or windrows shall be moved by blading or other acceptable methods. Clods or lumps of material shall be broken and mixed in an earth embankment so that a uniform material of uniform density is secured in each layer. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be uniformly applied, and it shall be the Contractor's responsibility to secure a uniform moisture content throughout each layer by such methods as shall be necessary. In order to secure uniform wetting of the earth embankment materials, the Contractor may apply water at the material source; such procedures shall be subject to the approval of the Engineer.

4. Earth embankment placed adjacent to and over pipes, culverts, arches, and bridges shall be of suitable material and shall be placed in successive layers approximately horizontal. Layers of embankment shall be brought up uniformly on each side of the structure and special care shall be taken to prevent any wedging action against the structure. For such distances along embankments adjacent to structures where it is impractical to obtain compaction by rolling, the embankment material shall be placed in layers not exceeding six (6) inches in depth of loose material, wetting uniformly to the moisture content directed, and shall then be compacted by methods approved by the Engineer, maintaining the required moisture content by additional sprinkling if necessary, until each layer has been uniformly compacted to the satisfaction of the Engineer, supplemented by such hand work as is necessary to secure the uniform and thoroughly compacted fill.

5. All earth cuts, full or part width in side hill, which are not required to be excavated below subgrade elevation for base or backfill shall be scarified to a uniform depth

of not less than six (6) inches below the grade, and the material shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with the hereinabove outlined requirements for earth embankments.

6. Rock embankments shall be composed principally of rock, and shall be constructed in successive layers for the full width of the specified depths of cross-sections and of eighteen (18) inches or less in depth. When, in the opinion of the Engineer, the sizes of rock require a greater depth of layer than the height of the rock embankment permits, the layer depths may be increased as necessary, but in no case shall the depth of the layer exceed two and one-half (2-1/2) feet. Each layer shall be constructed by starting at one end dumping the rock on top of the layer being constructed an then pushing the dumped material ahead in such a manner that the larger rock will be placed on the ground or preceding rock embankment layer, and the interstices between the larger stones will be filled with smaller stone and spalls by this operation and from the placing of succeeding loads of rock materials.

7. Maximum dimensions of any rock used in rock embankments will be less than the rock embankment layer, and in no case will any rock over two (2) feet in its maximum dimension be placed in the embankment. All oversized rock which is otherwise acceptable material shall be broken to the required dimension and utilized in the embankment construction where proposed by the plans or designated by the Engineer, except that where preferred by the Contractor and acceptable to the Engineer, such rock may be placed at other points where the embankment layer is of greater depth, thus requiring less breakage of rock. Wasting of excavated rock, other than that shown on the plans or ordered by the Engineer may be done by the Contractor only upon permission of the Engineer. Where excavated rock is to be wasted upon permission of the Engineer, the Contractor shall at his entire expense, replace the rock so wasted with other suitable materials.

8. The upper or final layer of rock embankment shall contain no stones larger than four (4) inches in their maximum dimension, and insofar as such is available by selection of the excavation, shall be composed of materials so graded that the maximum density and uniformity of the surface layer may be secured. Exposed oversized material shall be reduced in size by sledging or other approved methods.

9. Each rock embankment layer shall be rolled as directed by the Engineer, and where the embankment materials require, shall be sprinkled when and to the extent directed by the Engineer.

C. Material Selection: In addition to the foregoing selection of materials and utilization of the materials in the embankment, the embankment shall be constructed in proper

sequence to receive select materials specified or shown on the plans, with such modifications as may be directed by the Engineer. The layer of embankment immediately preceding the upper layer of select material shall be constructed to the required cross-section and elevation within tolerance of not more than one-tenth (1/10) of a foot from the established cross-section or elevation after proper compaction and finished to receive the select material.

D. Density: For each layer of earth embankment and select material, the relative compaction of the embankment when tested in accordance with ASTM D-2922 shall be at least ninety-five (95) percent of the maximum density as determined in accordance with ASTM D-698. After each section of earth embankment or select material is completed, such tests as are necessary will be made by the Contractor. If the material fails to meet the density specified, the compaction method will be altered as necessary to obtain the specified density.

3.10 FIELD QUALITY CONTROL:

A. Quality Control Testing During Construction: Provide testing of sub-grades and fill layers before further construction work is performed.

1. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.

3.11 MAINTENANCE:

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

1. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.12 DISPOSAL OF EXCESS AND WASTE MATERIALS:

A. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of it in a legal manner off Owner's property.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 31 37 00

RIPRAP

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Provide and place concrete, stone, cement-stabilized, or special riprap.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
   2. American Society for Testing and Materials (ASTM)
      a. D5519, Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials.
   3. TxDOT Departmental Material Specifications (DMS):
      a. DMS 6200, Filter Fabric.

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS [NOT USED]

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS [NOT USED]

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements
   1. Secure and maintain a location to store the material in accordance with Section 01 66 00.

1.11 FIELD CONDITIONS

A. Ambient Conditions
   1. Place mortar or grout only when the air temperature is above 40° F and rising.

2. For concrete riprap, follow all field condition requirements for concrete in accordance with Sections 03 00 00 and 32 13 13.

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-FURNISHED PRODUCTS [NOT USED]

2.2 MATERIALS

A. Reinforced Filter Fabric
   1. Provide Type 2 reinforced filter fabric in accordance with DMS-6200, if required.

B. Concrete Riprap
   1. Use concrete with a compressive strength of 4,000 psi at 28-days in accordance with Section 03 30 00.

C. Stone Riprap
   1. Use durable natural stone with a bulk specific gravity of at least 2.50 and a maximum weight loss of 18 percent after 5 cycles of magnesium sulfate solution.
   2. Common
      a. Use stones between 50 and 250 pounds.
      b. Use stones at least 3 inches in their least dimension.
      c. Use stones at least twice as wide as they are thick.
   3. Protection
      a. Use boulders or quarried rock that meets the gradation requirements of Table 1.
      b. Both the width and the thickness of each piece of riprap must be a least 1/3 of the length.
      c. Provide bedding stone that in-place meets the gradation requirements shown in Table 2 or as otherwise shown on the Drawings.
      d. Determine the gradation of the finished, in-place, riprap stone under the direct supervision of the City in accordance with ASTM D5519.

Table 1
Riprap Gradation Requirements

Thickness	Maximum Size (lb.)	90 percent Size[1] (lb.)	50 percent Size[2] (lb.)	8 percent Size[3], Minimum (lb.)
12 in.	200	80-180	30-75	3
15 in.	320	170-300	60-165	20
18 in.	530	290-475	105-220	22
21 in.	800	460-720	175-300	25
24 in.	1,000	550-850	200-325	30
30 in.	2,600	1,150-2.50	400-900	40

1. Defined such that 10% of the total riprap stone by weight is larger and 90% is smaller.
2. Defined such that 50% of the total riprap stone by weight is larger and 50% is smaller.
3. Defined such that 92% of the total riprap stone by weight is larger and 8% is smaller.

Table 2

Bedding Stone Gradation

Sieve Size (Square Mesh)	Percent by Weight Passing
3 inches	100
1-1/2 inches	50-80
3/4 inches	20-60
No. 4	0-15
No. 10	0-5

D. Grout

1. Provide grout with a ratio of 1-part portland cement to 3-parts sand and mixed with water until it achieves a consistency that will flow into and completely fill all voids.

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION

A. Grading

1. Grade and compact the slopes and other areas to be protected with riprap to match the line and grade shown on the plans.

3.4 INSTALLATION

A. Reinforced Filter Fabric

1. Place reinforced filter fabric with the length running up and down the slope, if required.
2. Ensure fabric has a minimum overlap of 2 feet.
3. Secure fabric with nails at least 2 inches long or U-shaped pins with legs at least 9 inches long.
4. Space nails or pins at a maximum 10 feet in each direction and 5 feet along seams.

B. Concrete Riprap

1. Reinforcement
   a. Reinforce concrete riprap with No. 3 reinforcing bars spaced at a maximum of 18 inches in each direction unless otherwise specified in the Drawings.
   b. Provide a minimum 6-inch lap at all splices.
   c. Place the first parallel bar no more than 6 inches from the edge of concrete and ensure between 1 and 3 inches of horizontal cover at the edge of riprap.
   d. Use approved supports to hold the reinforcement approximately equidistant from the top and bottom surface of the slab.
   e. Adjust reinforcement during concrete placement to maintain correct position.

f. Provide 2-inch weep holes on 10-foot centers located 2 feet above finished grade backed by 1 cubic foot of gravel and galvanized hardware cloth.
g. Provide additional rows of 2-inch weep holes for each 20 feet of riprap height, offset by 5 feet from the first row.

2. Subgrade
   a. Sprinkle and consolidate the subgrade before the concrete is placed ensuring all surfaces are moist.
   b. Compact each layer to a minimum of 98 percent standard proctor density with a moisture content not to exceed plus or minus 2 percent of optimum.
3. Compact and shape the concrete once it has been placed in accordance with the dimensions shown on the plans.
4. Finish the surface with a wood float after it has set sufficiently.
5. Provide a smooth surface or broom finish, as approved.
6. Cure the riprap immediately after the finishing operation in accordance with Section 32 13 13.

C. Stone Riprap
1. Provide the following types of stone riprap as specified in the Drawings:
   a. Dry Riprap
      1) Stone riprap with voids filled entirely with only spalls or small stones.
      2) Use spalls and small stones lighter than 25 pounds to fill open joints and voids in stone riprap, and place to a tight fit.
      3) Do not exceed a 6-inch variation between the tops of adjacent stones.
      4) Replace, embed deeper, or chip away stones that project more than the allowable amount above the finished surface.
   b. Grouted Riprap
      1) Common stone riprap with voids grouted after all stones are in place.
      2) Prevent earth, sand, or foreign material from filling the spaces between the stones.
      3) Wet the stones thoroughly after they are in place, fill the spaces between the stones with grout, and pack.
      4) Sweep the surface of the riprap with a stiff broom after grouting.
      5) Protect work from rapid drying for at least 3 days after placement.
2. Common
   a. Construct riprap as shown in Figure 1.
   b. Place stones on a bed excavated for the base course.
   c. Bed the base course of stone well into the ground with the edges in contact.
   d. Bed and place each succeeding course in even contact with the preceding course.
3. Protection
   a. Construct riprap as shown in Figure 2.
   b. Place riprap stone on the slopes within the limits specified in the Drawings.
   c. Place stone for riprap on the bedding material to produce a reasonably well-graded mass of riprap with the minimum practicable percentage of voids.
   d. Place riprap to its full thickness in a single operation.
   e. Avoid displacing the bedding material.

f. Ensure the entire mass of stones in their final position is free from objectionable pockets of small stones and clusters of larger stones.
g. Do not place riprap in layers, and do not place by dumping into chutes, dumping from the top of the slope, pushing from the top of the slope, or any method likely to cause segregation of the various sizes.
h. Obtain the desired distribution of the various sizes of stones throughout the mass by selective loading of material at the quarry or other source or by other methods of placement that will produce the specified results.
i. Rearrange individual stones by mechanical equipment or by hand if necessary to obtain a reasonably well-graded distribution of stone sizes.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections
1. Perform a size verification test in accordance with ASTM D5519 at least once per 5,000 square yards of finished riprap for all types of stone.
2. For installations greater than 5,000 square yards, do not place additional riprap until the initial size verification test has been approved.

3.6 ATTACHMENTS

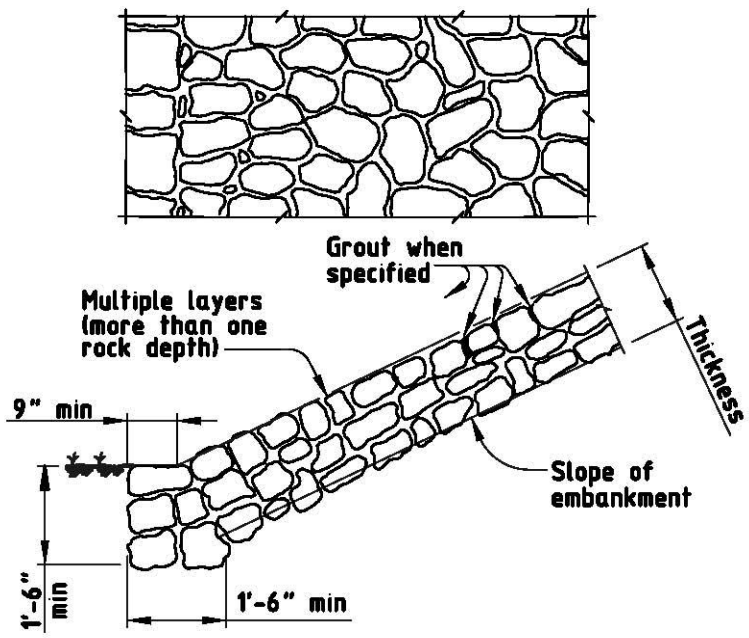


Figure 1 – Common Stone Riprap, dry or grouted

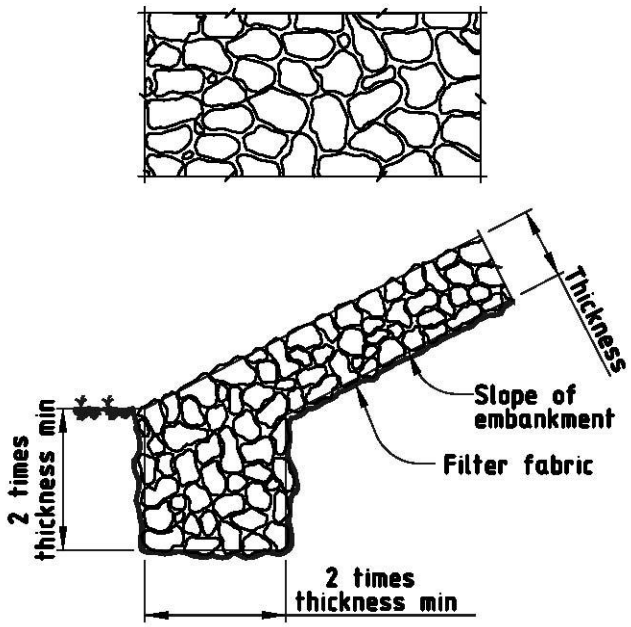


Figure 2 – Protection Stone Riprap

END OF SECTION

31 55 00

RETAINING WALL

PART 1 - GENERAL

1.01. DESCRIPTION

A. This work shall consist of furnishing materials and placement of Mechanically Stabilized Earth walls constructed in accordance with these specifications and in conformity with the lines, grades, design and dimensions shown on the contract drawings.

B. The Mechanically Stabilized Earth wall shall consist of a non-structural leveling pad, concrete face panels with specified architectural finishes, and soil reinforcement elements mechanically connected to each facing panel. Soil reinforcement shall have sufficient strength and frictional resistance and length as required by the design, as outlined in these specifications. Precast concrete coping units shall be installed at top of the wall panels.

1.02. MATERIALS

A. All materials and design drawings required for the MSE wall system shall be provided by the contractor through an approved wall system supplier. The Contractor, or the supplier as his agent, shall furnish the Owner's Representative a Certificate of Compliance certifying that the applicable materials comply with this section of the specifications. Materials not conforming to this section of the specifications shall not be used without written consent of the Owner's Representative.

B. Concrete Facing Panels

1. Concrete facing panels shall have a minimum thickness of 5 inches and a minimum concrete cover on reinforcing steel of 1-1/2 inches. Thicker panels shall be provided as required to accommodate architectural treatment or form liners specified in the contract drawings. Cement shall be Types I, or II and shall conform to the requirements of AASHTO M-85. Concrete shall have a compressive strength of 28 days in accordance with these specifications. All concrete requirements per spec section 03 30 00 shall be satisfied. Additives containing chloride shall not be used without the approval of the Owner's Representative. Attachment devices, connecting pins, PVC pipe and lifting devices shall be set in place to the dimensions and tolerances shown on the plans prior to casting.

2. Testing and Inspection: Acceptability of the precast unit will be determined on the basis of compressive strength tests and visual inspection. The precast units shall be considered acceptable regardless of curing age when compressive strength test results indicate the compressive strength will conform to the 28-day requirement. The Contractor, or his supplier, shall furnish facilities and perform all necessary sampling and testing in an expeditious and satisfactory manner.

C. Casting

1. The panels shall be cast face down in level forms supported on a flat working surface. Guides shall be used to locate and support attachment devices set in the back

face of the panel. The concrete in each unit shall be placed without interruption and shall be consolidated by the use of an approved vibrator, supplemented by such hand-tamping as may be necessary to force the concrete into the corners of the forms and prevent the formation of stone pockets or cleavage planes. Clear form oil or release agent shall be used throughout the casting operation.

D. Curing

1. The units shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength.

2. Removal of Forms

a) The forms shall remain in place until they can be removed without damage to the unit.

3. Concrete Finish

a) Concrete surface for the front face shall have architectural treatment or stamped concrete finishes as shown in the contract drawings and approved by the owner.

b) The rear face of the panel shall be free of open pockets of aggregate and surface distortions in excess of 1/4-inch.

c) Where shown on the contract drawings provide form liners, stamped concrete as shown.

E. Tolerances

1. All units shall be manufactured within the following tolerances with respect to the dimensions shown on the shop drawings:

a) Attachment Device Locations and Alignment: Lateral position of attachment device shall be within one inch. Embedment measured from the back face of the panel shall be within
+1/4 inch, -1/2 inch. Bearing surfaces of multiple attachment points for a single soil reinforcing element shall align within 1/16".

b) Panel Dimensions: All panel dimensions shall be within 1/4 inch. All hardware embedded in the panel with the exception of attachment devices shall be within 1/4 inch.

c) Panel Squareness: Squareness, as determined by the difference between the two diagonals, shall not exceed 1/2 inch.

d) Panel Surface Finish: Surface defects on smooth formed surfaces measured on a length of 5 feet shall not exceed 1/4-inch. Surface defects on textured-finished surfaces measured on a length of 5 feet shall not exceed 5/16-inch.

F. Compressive Strength

1. Acceptance of the concrete panels with respect to compressive strength will be determined on the basis of production lots. A production lot is defined as a group of panels that will be represented by a single compressive strength sample and shall consist of not more than 80 panels or a single day's production, whichever is less.
2. Compressive strength tests shall be performed on 6-inch diameter by 12-inch cylinders prepared in accordance with AASHTO T-23. During the production of the concrete panels, the manufacturer shall randomly sample the concrete in accordance with AASHTO T-141. A single set of compressive strength samples, consisting of a minimum of four (4) cylinders, shall be randomly selected for every production lot. For every compressive strength sample, a minimum of two cylinders shall be cured in the same manner as the panels and tested at seven (7) days or less.
3. The average compressive strength of these cylinders, when tested in accordance with AASHTO T-22, will determine the initial strength of the concrete. In addition, a minimum of two cylinders shall be cured in accordance with AASHTO T-23 and tested at 28-days. The average compressive strength of these two cylinders, when tested in accordance with AASHTO T-22, will determine the compressive strength of the production lot.
4. If the initial strength test results indicate a compressive strength greater than or equal to 4,000 pounds per square inch, then these test results will be utilized as the compressive strength test result for that production lot and the requirement for testing at 28-days will be waived for that particular production lot.
5. Acceptance of a production lot will be made if the compressive strength test result is greater than or equal to 4,000 pounds per square inch. If the compressive strength test result is less than 4,000 pounds per square inch, the acceptance of the production lot will be based on its meeting the following acceptance criteria in its entirety:
    a) Ninety (90) percent of the compressive strength test results for the overall production shall exceed 4,150 pounds per square inch.
    b) The average of any six (6) consecutive compressive strength test results, including the one in question, shall exceed 4,250 pounds per square inch.
    c) No individual compressive strength test result shall fall below 3,600 pounds per square inch.
6. In the event that a production lot fails to meet the specified compressive strength requirements, the production lot shall be rejected. Such rejection shall prevail unless the manufacturer, at their own expense, obtains and submits evidence of a type acceptable to the Owner's Representative that the strength and quality of the concrete placed within the panels of the production lot is acceptable. If such evidence consists of tests made on cores taken from the panels within the production lot, the cores shall be obtained and tested in accordance with AASHTO T-24.

G. Acceptance Criteria

1. Precast panels shall be accepted for use in wall construction provided the concrete strength meets or exceeds the minimum compressive strength requirement, the soil reinforcement connection devices and the panel dimensions are within tolerances and any

chipping, cracks, honeycomb or other defects are within acceptable standards for precast concrete as determined by the Owner's Representative.

2. Submit sample panels of each type of finish as required by the contract documents for approval. A mock up sample of each type MSE wall finish shall be installed for Owner's review and approval. The sample should also include precast coping on top of wall. The sample shall be 10ftx10ft minimum and shall be installed at a location identified by the owner.

H. Marking

1. The date of manufacture, the production lot number and the piece-mark, shall be clearly marked on the side of each panel.

I. Handling, Storage and Shipping

1. All units shall be handled, stored, and shipped in such a manner as to minimize the danger of chipping, cracks, fractures and excessive bending stresses. Panels shall be stored and shipped in stacks, front face down. Firm blocking, of sufficient thickness to prevent the attachment devices from contacting the panel above, shall be located immediately adjacent to the attachment devices.

2. Lifting inserts shall be installed on the top edge of the precast panels to permit lifting at the project site. Reinforcement connection inserts (tie strips or loop inserts) shall not be used for lifting or handling the panel.

1.03. SOIL REINFORCING AND ATTACHMENT DEVICES

A. All reinforcing and attachment devices shall be carefully inspected to insure they are true to size and free from defects that may impair their strength and durability.

1. Reinforcing Strips - Reinforcing strips shall be hot rolled from steel bars to the required shape and dimensions. Their physical and mechanical properties shall conform to ASTM A- 572 Grade 65 or equivalent. Galvanization for reinforcing strips shall conform to ASTM A- 123 applied at the rate of 2 ounces per square foot.

2. Reinforcing Mesh and Bar Mats - Reinforcing mesh and bar mats shall be shop fabricated of cold drawn steel wire conforming to the minimum requirements of ASTM A-82 and welded into the finished mesh fabric in accordance with ASTM A-185. The longitudinal and transverse wires shall be of the same size. Galvanization shall be applied after the mesh is fabricated and conform to the minimum requirements of ASTM A-123 applied at the rate of 2 ounces per square foot.

3. Tie Strips - The tie strips shall be shop fabricated of a hot rolled steel conforming to the minimum requirements of ASTM 570, Grade 50 or equivalent. Galvanization shall conform to ASTM A-123.

4. Fasteners - Fasteners shall consist of hexagonal cap screw bolts and nuts, which are galvanized and conform to the requirements of ASTM A-325 or equivalent.

5. Connector Bars and Pins - Connector bars and pins shall be fabricated from cold drawn

steel wire conforming to the requirements of ASTM A-82 and be galvanized in accordance with ASTM A-123.

6. Structural Connectors - Structural plate connectors and fasteners used for yokes to connect reinforcements to wall panels around pile or utility conflicts shall conform to the material requirements of Reinforcing Strips and Fasteners, Items 1 and 4, stated above.

1.04. JOINT MATERIALS

A. Installed to the dimensions and thicknesses in accordance with the plans or approved shop drawings.

1. Bearing Pads

a) Bearing pads shall be a preformed EPDM rubber pads conforming to ASTM D-2000 M2AA 807, having a durometer hardness of 80 ± 5.

2. Joint Cover

a) When required, as shown on the plans, horizontal and vertical joints between panels shall be covered by a geotextile. The geotextile may be either a non-woven needle punched polyester geotextile or a woven monofilament polypropylene geotextile as approved by the wall supplier. Adhesive used to hold the filter fabric material to the rear of the facing panels prior to backfill placement shall be approved by the wall supplier.

b) Coordinate joints between different types of walls. Install filter fabric at all such joints to maintain integrity of backfill materials behind walls.

1.05. SELECT GRANULAR BACKFILL MATERIAL

A. The select granular backfill material used in the mechanically stabilized earth structure shall conform to the requirements of ITEM 423.2.C of the Texas DOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges 2004.

B. Backfill not conforming to this specification shall not be used without the written consent of both the Owner's Representative and the wall supplier.

C. The frequency of sampling of Select Granular Backfill necessary to assure gradation control throughout construction shall be as directed by the Owner's Representative.

1.06. GENERAL REQUIREMENTS

A. The Contractor shall prepare and submit working drawings and design calculations. Construction drawings and design calculations shall bear the seal of a Professional Engineer Registered in the State of Texas. All appurtenances behind, in front of, under, mounted upon, or passing through the wall such as drainage structures, utilities, or other appurtenances shown on the plans shall be accounted for in the stability design of the wall. The contractor shall hire a geotechnical engineer licensed in the state of Texas to determine

the properties of backfill and bearing stratum, and perform stability analysis of MSE wall system.

B. Leveling pad elevations may vary from the elevations shown on the plans. Unless otherwise noted on the plans, two (2) foot minimum cover shall be provided from the top of the leveling pad to finish grade. Design calculations shall include a summary of all design parameters used, including material types, strength values and assumed allowable, assumed loads and loading combinations, and factor of safety parameters.

C. Where walls or wall sections intersect with an angle of 130^{o} or less on the backfill side, a special vertical corner element panel shall be used. The corner element panels shall cover the joint of the panels that abut the corner, and allow for independent movement of the abutting panels. Corner elements shall not be formed by connecting standard facing panels that abut the acute corner.

D. The face panels shall be designed to accommodate differential settlement of 6 inches in 100 feet.
The spacing between adjacent panels shall be designed to be at least 0.5 inches. Where shown on the plans, slip joints to accommodate excessive differential settlement shall be included.

1.07. DESIGN REQUIREMENTS

A. The design by the wall system supplier shall consider the internal stability of the wall mass. The design calculations and drawings shall be submitted to the project geotechnical engineer for review of global stability criteria. Design walls shall be in accordance with AASHTO LRFD Bridge Design Specifications and TxDOT specifications.

1. Failure Plane

a) The theoretical failure plane within the reinforced soil mass shall be analyzed so that the soil stabilizing components extend sufficiently beyond the failure plane to stabilize the material. Design calculations must utilize a failure surface as previously determined by strain gauges on test surfaces to measure tensile forces along the reinforcements. A plot of the maximum stress at each level of reinforcement shall determine the failure surface. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, slope surcharge, hydrostatic and seismic loads, shall be accounted for in the design.

2. Hydrostatic Forces

a) Unless specified otherwise, when a design high-water surface is shown on the plans at the face of the wall, the design stresses calculated from that elevation to the bottom of wall must include a 3 foot differential head of saturated backfill. In addition, the buoyant weight of saturated soil shall be used in the calculation of pullout resistance.

3. Backfill

a) The friction angle of the select backfill used in the reinforced fill zone for the internal stability design of the wall shall be determined by the project geotechnical

engineer and shall be submitted for approval. The friction angle shall be determined by the standard direct shear test, AASHTO T-236, utilizing a sample of the material compacted to 95% of AASHTO T-99, Methods C or D (with oversize correction, as outlined in Note 7), at optimum moisture content.

b) Before construction begins, borrow selected shall be subject to approval to show conformance with this frictional requirement. Compliance with the test requirements shall be the responsibility of the Contractor. The friction angle of the foundation soils and random backfill shall be determined by the approved wall supplier and submitted for review and approval.

4. Surcharge

a) MSE walls shall be designed to support all surcharge loading from the backfill and retaining walls perched above the MSE walls.

5. Safety Factors

a) The minimum factors of safety shall be as follows:

i.) 1.5 for pullout based on pullout resistance at 0.75 inch deformation for a representative backfill

ii.) 1.5 for sliding

iii.) 2.0 for overturning

iv.) 2.0 for panel connection pullout or rupture at the end of the design life for the maximum allowable reinforcement tension.

6. Connections

a) All connections shall be positive and adequacy and capacity of panel connections shall be demonstrated by providing test data from pullout and flexural tests on full size panels with all connections loaded simultaneously.

b) For systems using “loop” type connections or other non-bolted connections, the distribution of stress in each longitudinal reinforcement shall be shown to be below the maximum allowable tension in the reinforcement. Test data from an independent laboratory shall be supplied to document the stress distribution on representative sample connections of a full width specimen. For systems not meeting the above requirement, a bolted connection will be required.

c) For steel reinforcements, including tie strips and loop inserts, the following metal loss rates shall be assumed:

i.) Zinc (first 2 years): 15 microns/year/side

ii.) Zinc (subsequent years to depletion): 4 microns/year/side

iii.) Carbon Steel (after depletion of zinc): 12 microns/year/side

iv.) Carbon Steel (75 to 100 years): 7 microns/year/side

d) The allowable tensile stress in steel reinforcements and connections including tie strips and loop inserts, F_t, at the end of service life, shall conform to the following:

i.) Systems using linear reinforcements (strips):

a. $F_t = 0.55\ F_y$ at the reduced gross section (minimum cross section).

b. $F_t = 0.50\ F_u$ at the net section at bolt hole (applicable to bolted connections only).

ii.) Systems with bar mats or welded wire mesh:

a. $F_t = 0.48\ F_y$ at all sections.

7. Reinforcement Length

a) The soil reinforcement shall be the same length from the bottom to the top of each wall section. The reinforcement length defining the width of the entire reinforced soil mass may vary with wall height.

b) The minimum length of the soil reinforcement shall be designed by the approved wall supplier.

8. Steel Reinforcements: Steel reinforcements, including tie strips and loop inserts, shall be galvanized steel per TxDOT standards.

1.08. SUBMITTALS

A. The Contractor shall submit design calculations and design drawings for approval prior to beginning construction. Calculations shall be sealed by a Professional Engineer registered in the state of Texas.

1. The design drawings shall include all details, dimensions, and cross-sections necessary to construct the wall and shall include, but shall not be limited to the following:

a) An elevation sheet or sheets for each wall.

b) An elevation view of the wall which shall include the elevation at the top of the wall at all horizontal and vertical break points and at least every 50 feet along the face of the wall, all steps in the leveling pads, the designation as to the type of panel, the length of soil reinforcing elements, the distance along the face of the wall to where changes in length of the soil reinforcing elements occur, and an indication of the final ground line and maximum calculated bearing pressures.

c) A typical cross section or cross sections showing the elevation relationship between ground conditions and proposed grades.

d) General notes pertaining to design criteria and wall construction.

2. All panel details shall show all dimensions necessary to construct the element, all

reinforcing steel in the element, and the location of soil reinforcing connection devices embedded in the panels.

3. Clearly indicated details for construction of walls around drainage facilities.

4. Details of the architectural treatment including form liners and patterned concrete shall be included.

5. The details for diverting soil reinforcements around obstructions such as piles, catch basins, and other utilities.

6. The details for connections between the concrete panel and the soil reinforcements.

7. Installation details of backfill drain pipe at the base of the backfill.

8. Details of precast coping at the top of the wall and proposed guardrail attachment to the coping.

PART 2 - PRODUCTS

2.01. APPROVED WALL SYSTEM SUPPLIERS

A. MSE wall system shall be by one of the following

1. Reinforced Earth Wall, Euless TX.

2. Tensar Retaining Wall System, Georgia

3. Or TX DOT approved wall system supplier.

PART 3 - EXECUTION

3.01. WALL EXCAVATION

A. Contractor shall coordinate excavations and/or fills required for MSE wall system installation with contract drawings.

3.02. FOUNDATION PREPARATION

A. The foundation for the structure shall be graded level for a width equal to or exceeding the length of the soil reinforcements, or as shown on the plans. Prior to wall construction, the foundation, if not in rock, shall be compacted as specified in the design drawings. Any foundation soils found to be unsuitable shall be removed and replaced as directed by the Owner's Representative.

B. At each panel foundation level, a concrete leveling pad shall be provided as shown on the plans. The requirements for leveling pads shall be determined by the approved wall system supplier.

3.03. WALL ERECTION

A. Precast concrete panels shall be placed vertically with the aid of a light crane. For erection, panels are handled by means of a lifting device set into the upper edge of the panels. Panels should be placed in successive horizontal lifts in the sequence shown on the plans as backfill placement proceeds. Any temporary bracing required shall be determined and installed by the contractor. Vertical tolerances (plumbness) and horizontal alignment tolerances shall not exceed ¾ inch. The allowable offset in any panel joint shall be ¾ inch. The maximum allowable offset in any panel joint shall be ¾ inch. The overall vertical tolerance of the wall (plumbness from top to bottom) shall not exceed ¾ inch per 10-feet of wall height.

3.04. PLACEMENT OF REINFORCEMENTS

A. Prior to placing the first layer of reinforcements (strips, mats or grids), backfill shall be placed and compacted in accordance with Section 3.5, Backfill Placement.

B. Bending of soil reinforcements in a horizontal plane that results in a permanent deformation in their alignment shall not be allowed. Gradual bending in the vertical direction that does not result in permanent deformations is allowable.

C. Connection of reinforcements to piles or bending of reinforcements around piles shall not be allowed. Cutting of reinforcement longitudinal or transverse bars shall not be allowed to avoid conflicts with piles or utility obstructions.

D. A structural connection (yoke) from the wall panels to the reinforcement shall be used whenever it is necessary to avoid cutting or excessive skewing of reinforcements due to pile or utility conflicts.

E. Soil reinforcements shall be placed normal to the face of the wall, unless otherwise shown on the plans or directed by the Owner's Representative. If a rotatable bolted connection is used, the skewing of the soil reinforcements is permitted to avoid obstructions in the reinforced fill. The maximum skew angle shall be supported by design calculations.

3.05. BACKFILL PLACEMENT

A. Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the facing panels. Any wall materials which become damaged or disturbed during backfill placement shall be either removed and replaced at the Contractor's expense or corrected as directed by the Owner's Representative. Any backfill material placed within the reinforced soil mass which does not meet the requirements of this specification shall be corrected or removed and replaced at the Contractor's expense, as directed by the Owner's Representative.

B. Backfill shall be compacted to 95 percent of the maximum density as determined by AASHTO T-99, Method C or D (with oversize correction as outlined in Note 7).

C. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have a placement moisture content less than or equal to the Optimum Moisture Content. Backfill material with

a placement moisture content in excess of the Optimum Moisture Content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift. The Optimum Moisture Content shall be determined in accordance with AASHTO T-99, Methods C or D (with oversize correction as outlined in Note 7).

D. The frequency of sampling select granular backfill material, necessary to assure gradation control throughout construction, shall be as directed by the Owner's Representative. If 30 percent or more of the select granular backfill material is greater than 3/4-inch in size, AASHTO T-99 is not applicable. For such a material, the acceptance criterion for control of compaction shall be either a minimum of 70 percent of the relative density of the material as determined by ASTM D-4253 and D-4254, or a method specification, based on a test compaction section, which defines the type of equipment, lift thickness, number of passes of the specified equipment and placement moisture content.

E. The maximum lift thickness after compaction shall not exceed 10-inches, regardless of the vertical spacing between layers of soil reinforcements. The Contractor shall decrease this lift thickness if necessary, to obtain the specified density. Prior to placement of the soil reinforcements, the backfill elevation, after compaction, shall be 2 inches above the attachment device elevation from a point approximately 12 inches behind the back face of the panels to the free end of the soil reinforcements, unless otherwise shown on the plans.

F. Compaction within 3 feet of the back face of the panels shall be achieved by at least three (3) passes of a lightweight mechanical tamper, roller or vibratory system. The specified lift thickness shall be adjusted as warranted by the type of compaction equipment actually used, but no soil density tests need be taken within this area. Care shall be exercised in the compaction process to avoid misalignment of the panels or damage to the attachment devices. Heavy compaction equipment shall not be used to compact backfill within 3 feet of the wall face.

G. At the end of each day's operation, the Contractor shall slope the last level of backfill away from the facing to rapidly direct runoff of rainwater away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

END OF SECTION

SECTION 31 63 29

DRILLED CONCRETE PIERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Drilled piers.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 03 20 00 – Concrete reinforcement

3. Section 03 30 30 – Cast-in-Place Concrete.

C. Unit Prices:

1. Measurement:

a. Length of drilled piers for payment to be measured from tip to cut off elevation.

b. Any drilled pier length extending above cut off elevation indicated will not be measured for payment.

c. Drilled pier lengths extending below authorized tip elevation will not be measured for payment.

2. Payment:

a. Contract bid price for piling to be based on the total number, length, and diameter of drilled piers, and reinforcing steel indicated on Drawings.

b. Bid price to include all costs for drilled pier drilling, removing excavated material; furnishing, placing, and removing casing where required; dewatering where necessary; furnishing and placing concrete; reinforcing steel; dowels; any other associated materials; and furnishing all labor, equipment, installation supervision and accessories required for complete pile installation as shown on the Drawings and indicated in this Specification Section.

c. Adjustment to bid price for drilled pier length to be made in accordance with unit prices in the Bid Proposal.

1) Indicate on Bid Proposal Form a single unit price per lineal foot, for each drilled pier of a given diameter as shown on the Drawings.

2) These prices will be used to determine any additional amount due to Contractor if Engineer orders an increase in drilled pier length, or adjustments due to aborted piers, or credit due to Owner if decrease in drilled pier length is ordered.

3) No payments for changes in length will be made unless changes are directed by Engineer and such order is verified in writing.

4) No price adjustment will be made for individual drilled piers but will be made on the total lineal footage of drilled pier installed for each diameter.

d. No payment will be made for the following:

1) Drilled piers placed outside of specified tolerances.

2) Drilled piers disapproved by Engineer for reasons stated elsewhere in this Specification Section.

e. Contractor will be paid for all shafts drilled and terminated and new foundations placed due to underground obstructions at unit price indicated in bid documents.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Concrete Institute (ACI):

a. 305R, Hot Weather Concreting.

b. 306R, Cold Weather Concreting.

c. 336.1, Specification for the Construction of Drilled Piers.

d. 336.3R, Report on Design and Construction of Drilled Piers.

2. ASTM International (ASTM):

a. A36, Standard Specification for Carbon Structural Steel.

b. A252, Standard Specification for Welded and Seamless Steel Pipe Piles.

3. Building code:

a. International Code Council (ICC):

1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:

1. Installer to have a minimum of five years' experience in installing drilled piers in soils similar to those to be encountered on this Project site.

C. Monitoring

1. The laboratory and OWNER representative shall monitor all pier drilling operations. CONTRACTOR shall give a minimum two days' notice to the laboratory for services in conjunction with drilled piers.

1.03 DEFINITIONS

A. Installer or Applicator:

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

1.04 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.

2. Fabrication and/or layout drawings.

a. Log of installation of all drilled piers.

b. Shop Drawings of all reinforcing, anchor bolts, dowels and accessories required for the drilled piers.

3. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

c. Proposed concrete mix design for drilled piers: For each class of

d. concrete. Include revised mix proportions when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

e. Laboratory Test Reports: For evaluation of concrete materials and mix design.

4. Certifications.

B. Qualifications:

1. Records for a minimum of three previous installations by the Contractor of required type of pile and in similar soil conditions.

C. Informational Submittals:

1. Copies of concrete strength tests for concrete placed in the drilled piers.

2. Drilled pier installation log.

PART 2 PRODUCTS

2.01 CONCRETE

A. Concrete:

1. 28-day minimum compressive strength: 4000 PSI.

2. Comply with Specification Section 03 30 00.

2.02 REINFORCING STEEL

A. Provide reinforcing steel conforming to requirements of Specification Section 03 20 00

1. Reinforcing sizes, number, configurations, spacing, and lengths to be as indicated on Drawings.

PART 3 EXECUTION

3.01 LINES AND LEVELS

A. Furnish lines and levels necessary for drilled pier installation.

1. Contractor is solely responsible for final placement and location of drilled piers.

B. As-installed pile coordinates shall be surveyed by the Contractor.

1. Include field survey of final cut off elevation of each pile.

2. Provide access to Engineer for all installed piles.

3.02 INSTALLATION

A. Provide drilled piers with straight shafts of uniform required diameter as indicated.

B. Drilled pier bottom elevation or elevations indicated on the Drawings are to be used as a guide and shall be used for bid purposes.

1. Final elevation or elevations of bottom of drilled piers shall be as determined and directed by Geotechnical Engineer.

C. Provide temporary steel casing in drilled pier holes as required to allow cleaning and inspection of the bottom of each drilled pier, to prevent caving in and to prevent entering of ground water into the drilled pier holes.

1. Casing to be steel cylinders of adequate thickness as required to support all loadings encountered during drilled pier installation.

2. Casing steel to conform to requirements of either ASTM A252, Grade 2, or ASTM A36.

3. Weld sections of casing together with continuous full penetration welds to make all joints watertight.

D. Maintain bottom of drilled pier excavations free of loose, wet, soft or frozen materials, mud, snow and water until drilled pier concrete is placed.

1. Prevent, by whatever means are necessary, the drilled pier bottom excavations from becoming loose, wet, frozen or soft before drilled pier concrete is placed.

2. In no case shall there be more than a 1 -inch depth of water at bottom of drilled pier at time of concrete placement.

3. Excavate drilled pier bottoms to a level plane.

E. Remove materials resulting from excavating for drilled piers to an area

1. Remove excavated materials from around drilled pier holes as soon as excavation for holes has been completed.

F. Provide gas testing equipment, ventilation equipment, protective cage, and other safety equipment required for inspection and cleaning of drilled pier excavations or for any other operations necessitating entry into drilled pier holes.

G. Do not begin excavation for any drilled piers until the Geotechnical Engineer is present to witness the excavation.

1. The bottom subgrade of each drilled pier at time of placing pier concrete shall be at an elevation which will provide the drilled pier with the following properties:

a. Free of loose, wet, soft or frozen materials.

b. Free of water exceeding a 1 -inch maximum depth.

1) Indicate uplift force on the Drawings.

c. Is at a minimum depth as indicated on the drawings.

H. Do not place drilled pier concrete until the Owner's testing laboratory representative approves the bottom subgrade of the drilled pier for the above requirements.

I. When drilled pier bottom subgrade does not meet the requirements of this Specification Section, take corrective action as directed by the Geotechnical Engineer to bring bottom subgrade into conformance to requirements.

J. After approval of drilled pier bottom subgrade is obtained and after Engineer approves placement of drilled pier reinforcing steel, dowels and anchor bolts, place drilled pier concrete as soon as possible, in manner that will preclude segregation of concrete aggregates, infiltration of water and soil, or any other occurrence which would tend to decrease strength of concrete or supporting capacity of finished drilled pier.

1. Limit concrete free fall to four (4) feet.

2. Cover open holes for protection of workmen, and to keep out foreign materials until concrete is placed.

3. Drill and place concrete for a drilled pier in one day's time.

4. Place concrete in a continuous manner to prevent cold joints from forming.

5. Do not allow concrete to free fall through reinforcing steel.

K. When concrete free fall is potentially greater than four (4) feet, use tremie method to place concrete.

1. Use tremie pipe between 6-inch and 8-inch diameter.

2. Provide positive control to ensure that bottom of tremie pipe is at all times below concrete surface.

L. In withdrawing casing used to brace drilled pier excavation and maintain water tightness during concrete placement, always keep bottom of casing below top of concrete surface to prevent a reduction in diameter of drilled pier shaft due to earth pressure and to prevent soil and ground water from entering and mixing with the concrete.

1. Pull casing by uniform vertical lifts, continuously plumb, in such a manner to allow continuous observation of interior level of concrete.

2. Pull casing at a uniform rate.

M. Vibrate top six feet of drilled pier concrete.

1. Vibrate each two (2) feet lift of this top six (6) feet prior to subsequent concrete being placed.

2. Perform vibration after casing has been withdrawn if casing is not permanent.

N. Surface of drilled pier at cut off elevation to be level with diameter required by Drawings.

1. Where top surface of drilled pier has a mushroomed configuration, remove excess concrete in such manner to prevent damage to top of drilled pier and to provide drilled pier of diameter required.

O. If during drilling, an underground obstruction prevents shaft from being drilled to required depth, terminate shaft and fill with concrete.

1. Notify Engineer so a new drilled pier arrangement and foundation can be designed to replace terminated shaft.

P. Do not place concrete for drilled piers against soft, loose or frozen ground.

Q. After placement of concrete for a drilled pier is completed, cure exposed top surface of drilled pier for a minimum of seven days.

1. When outside temperature falls below 40^0 F, maintain temperature of exposed top surface of drilled piers at a minimum of 50^0 F during the curing period.

2. Follow recommendations of ACI 306R for curing concrete in cold weather and recommendations of ACI 305R for curing concrete in hot weather.

3.03 SUPERVISION AND INSPECTION

A. Drilled pier installer to provide qualified, experienced person in his employ to supervise all drilling and concrete filling of all drilled piers.

3.04 TOLERANCES

A. Place each drilled pier plumb at locations indicated.

1. Maximum allowable tolerance from true vertical measured from center of shaft shall not exceed more than 1.5 % of the drilled pier length, 12.5% of shaft diameter, or 1.5-inch whichever is less.

2. Shaft at cut off elevation shall not be off center horizontally from its required location more than 1/24 of shaft diameter or 2-inch, whichever is less.

3. If tolerances are exceeded, Contractor to pay for corrective design and construction that may be required.

3.05 REINFORCEMENT

A. Place steel reinforcing cage in drilled pier holes as indicated after Geotechnical Engineer has approved drilled pier bottom subgrade and before placing concrete.

1. Adequately support reinforcement by means to ensure indicated vertical position, concentric alignment and required concrete cover over reinforcing steel.

2. Provide additional reinforcing steel in drilled piers as directed by Engineer due to revised condition of drilled pier installation.

3. Place all dowels and anchor bolts extending from tops of drilled piers immediately after concrete shaft has been fully placed.

3.06 DISAPPROVED DRILLED PIERS

A. Drilled piers will be disapproved and replaced as directed by Engineer for following reasons:

1. Concrete not reaching minimum required 28 day compressive strength, or containing cracks, voids, soft material, inclusions of earth or other foreign materials, or any other defect which, in the opinion of the Engineer, may affect the strength of the drilled pier.

2. Drilled piers out of horizontal and vertical alignment in excess of tolerances specified.

3. Drilled piers of improper size and depth, and drilled piers suspected to be of incorrect diameter due to any reason.

B. Any additional drilled piers or additional construction required due to disapproved drilled piers will be placed by Contractor at no additional expense to Owner.

C. Reimburse Engineer for any additional engineering work required for redesign due to disapproved drilled piers.

3.07 FIELD QUALITY CONTROL

A. Concrete testing in accordance with Section 03 30 00 - Cast-in-Place Concrete.

3.08 DRILLED PIER RECORDS

A. Keep a log of each installed drilled pier including:

1. Drilled pier location by column grid lines or by other means.

2. Date drill pier was installed.

3. Bottom elevation of drilled pier.

4. Cut off elevation of drilled pier.

5. Total length of drilled pier from bottom to cut off elevation.

6. Diameter of drilled pier shaft.

7. Diameter and height of belled bottom.

8. Whether or not hole was cased.

9. Deviation from allowable installation tolerances.

10. Stratigraphy of subgrade materials encountered during drilling.

11. Concrete delivery ticket truck numbers used to fill drilled pier.

B. After all drilled piers are installed, submit copy of complete drilled pier logs to Engineer.

1. Report to be signed by Contractor and Testing Agency/Special Inspector.

END OF SECTION

SECTION 32 11 23
Flexible Base Courses

PART 1 - PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Section Includes:
1. Foundation course for surface course or for other base course composed of flexible base constructed in one or more courses in conformity with the typical section.

B. Deviations from this City of Fort Worth Standard Specification
1. None

C. Related Specification Sections include, but are not necessarily limited to:
1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract

2. Division 1 – General Requirements

1.02 PRICE AND PAYMENT PROCEDURES:

A. Measurement and Payment
1. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

B. The price bid shall include:
a. Preparation and correction of subgrade
b. Furnishing of material
c. Hauling
d. Blading
e. Sprinkling
f. Compacting

1.03 REFERENCES:

A. Definitions
1. RAP – Recycled Asphalt Pavement.

B. Reference Standards
1. Reference standards cited in this specification refer to the current reference standard published at the time of the latest revision date logged at the end of this specification unless a date is specifically cited.
2. ASTM International (ASTM):

3. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))
4. Texas Department of Transportation (TXDOT):
5. Tex-104-E, Determining Liquid Limits of Soils
6. Tex-106-E, Calculating the Plasticity Index of Soils
7. Tex-107-E, Determining the Bar Linear Shrinkage of Soils
8. Tex-110-E, Particle Size Analysis of Soils
9. Tex-116-E, Ball Mill Method for Determining the Disintegration of Flexible Base Material
10. Tex-117-E, Triaxial Compression for Disturbed Soils and Base Materials
11. Tex-411-A, Soundness of Aggregate Using Sodium Sulfate or Magnesium Sulfate
12. Tex-413-A, Determining Deleterious Material in Mineral Aggregate

2.01 MATERIALS

A. General

1. Furnish uncontaminated materials of uniform quality that meet the requirements of the Drawings and specifications.
2. Obtain materials from approved sources.
3. Notify City of changes to material sources.
4. The City may sample and test project materials at any time before compaction throughout the duration of the project to assure specification compliance.

B. Aggregate

1. Furnish aggregate of the type and grade shown on the Drawings and conforming to the requirements of Table 1.
2. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for the grade specified.
3. Do not use additives such as but not limited to lime, cement, or fly ash to modify aggregates to meet the requirements of Table 1, unless shown on the Drawings.

Table 1
Material Requirements

Property	Test Method	Grade 1	Grade 2
Master gradation sieve size (% retained)	Tex-110-E		
2-1/2 in		–	0
1-3/4 in		0	0–10
7/8 in		10–35	–
3/8 in		30–50	–
No. 4		45–65	45–75
No. 40		70–85	60–85
Liquid limit, % max.[1]	Tex-104-E	35	40
PlastiCity index, max.[1]	Tex-106-E	10	12
Wet ball mill, % max.[2]	Tex-116-E	40	45
Wet ball mill, % max. increase passing the No. 40 sieve		20	20
Classification[3]	Tex-117-E	1.0	1.1–2.3
Min. compressive strength[3], psi			
lateral pressure 0 psi		45	35
lateral pressure 15 psi		175	175

1. Determine plastic index in accordance with Tex-107-E (linear shrinkage) when liquid limit is unattainable as defined in Tex-104-E.
2. When a soundness value is required by the Drawings, test material in accordance with Tex-411-A.
3. Meet both the classification and the minimum compressive strength, unless otherwise shown on the Drawings.

1. Material Tolerances
   a. The City may accept material if no more than 1 of the 5 most recent gradation tests has an individual sieve outside the specified limits of the gradation.
   b. When target grading is required by the Drawings, no single failing test may exceed the master grading by more than 5 percentage points on sieves No. 4 and larger or 3 percentage points on sieves smaller than No. 4.
   c. The City may accept material if no more than 1 of the 5 most recent plasticity index tests is outside the specified limit. No single failing test may exceed the allowable limit by more than 2 points.
1. Material Types
   a. Do not use fillers or binders unless approved.
   b. Furnish the type specified on the Drawings in accordance with the following:
2. Type A

a. Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source.
b. Do not use gravel or multiple sources.

3. Type B
   a. Only for use as base material for temporary pavement repairs.
   b. Do not exceed 20 percent RAP by weight unless shown on Drawings.
4. Type D
   a. Type A material or crushed concrete.
   b. Crushed concrete containing gravel will be considered Type D material.
   c. The City may require separate dedicated stockpiles in order to verify compliance.
   d. Crushed concrete must meet the following requirements:
   e. Table 1 for the grade specified.
   f. Recycled materials must be free from reinforcing steel and other objectionable material and have at most 1.5 percent deleterious material when tested in accordance with TEX-413-A.

A. Water

1. Furnish water free of industrial wastes and other objectionable matter.

PART 2 - PART 3 EXECUTION

3.01 PREPARATION

A. General

1. Shape the subgrade or existing base to conform to the typical sections shown on the Drawings or as directed.
2. When new base is required to be mixed with existing base:
   a. Deliver, place, and spread the new flexible base in the required amount.
   b. Manipulate and thoroughly mix the new base with existing material to provide a uniform mixture to the specified depth before shaping.

B. Subgrade Compaction

1. Proof roll the roadbed before pulverizing or scarifying in accordance with the following:

C. Proof Rolling

1. City Project Representative must be on-site during proof rolling operations.
2. Use equipment that will apply sufficient load to identify soft spots that rut or pump.
   a. Acceptable equipment includes fully loaded single-axle water truck with a 1500-gallon capacity.
3. Make at least 2 passes with the proof roller (down and back = 1 pass).
4. Offset each trip by at most 1 tire width.
5. If an unstable or non-uniform area is found, correct the area.

D. Correct

1. Soft spots that rut or pump greater than 3/4 inch
2. Areas that are unstable or non-uniform

3. Installation of base material cannot proceed until compacted subgrade approved by the City.

3.02 INSTALLATION

A. General

1. Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content.
2. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the Drawings or as directed.
3. Haul approved flexible base in clean, covered trucks.

B. Equipment

1. General
   2.01.1.1.1 Provide machinery, tools, and equipment necessary for proper execution of the work.
2. Rollers
   a. The Contractor may use any type of roller to meet the production rates and quality requirements of the Contract unless otherwise shown on the Drawings or directed.
   b. When specific types of equipment are required, use equipment that meets the specified requirements.
   c. Alternate Equipment.
1. Instead of the specified equipment, the Contractor may, as approved, operate other compaction equipment that produces equivalent results.
2. Discontinue the use of the alternate equipment and furnish the specified equipment if the desired results are not achieved.
   a. City may require Contractor to substitute equipment if production rate and quality requirements of the Contract are not met.

C. Placing

1. Spread and shape flexible base into a uniform layer by approved means the same day as delivered unless otherwise approved.
2. Place material such that it is mixed to minimize segregation.
3. Construct layers to the thickness shown on the Drawings, while maintaining the shape of the course.
4. Where subbase or base course exceeds 6 inches in thickness, construct in 2 or more courses of equal thickness.
5. Minimum lift depth: 3 inches
6. Control dust by sprinkling.
7. Correct or replace segregated areas as directed.
8. Place successive base courses and finish courses using the same construction methods required for the first course.

D. Compaction

1. General
   a. Compact using density control unless otherwise shown on the Drawings.

b. Multiple lifts are permitted when shown on the Drawings or approved.
c. Bring each layer to the moisture content directed. When necessary, sprinkle the material to the extent necessary to provide not less than the required density.
d. Compact the full depth of the subbase or base to the extent necessary to remain firm and stable under construction equipment.

2. Rolling
   a. Begin rolling longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least 1/2 the width of the roller unit.
   b. On superelevated curves, begin rolling at the low side and progress toward the high side.
   c. Offset alternate trips of the roller.
   d. Operate rollers at a speed between 2 and 6 mph as directed.
   e. Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted.
   f. Continue work until specification requirements are met.
   g. Proof roll the compacted flexible base in accordance with the following:
3. Proof Rolling
   a. City Project Representative must be on-site during proof rolling operations.
   b. Use equipment that will apply sufficient load to identify soft spots that rut or pump.
   c. Acceptable equipment includes fully loaded single-axle water truck with a 1500 gallon capacity.
   d. Make at least 2 passes with the proof roller (down and back = 1 pass).
   e. Offset each trip by at most 1 tire width.
   f. If an unstable or non-uniform area is found, correct the area.

E. Correct
   a. Soft spots that rut or pump greater than 3/4 inch.
   b. Areas that are unstable or non-uniform.

1. Tolerances
   a. Maintain the shape of the course by blading.
   b. Completed surface shall be smooth and in conformity with the typical sections shown on the Drawings to the established lines and grades.
   c. For subgrade beneath paving surfaces, correct any deviation in excess of 1/4 inch in cross section in length greater than 16 feet measured longitudinally by loosening, adding or removing material. Reshape and recompact by sprinkling and rolling.
   d. Correct all fractures, settlement or segregation immediately by scarifying the areas affected, adding suitable material as required. Reshape and recompact by sprinkling and rolling.
   e. Should the subbase or base course, due to any reason, lose the required stability, density and finish before the surfacing is complete, it shall be recompacted at the sole expense of the Contractor.
2. Density Control
   a. Minimum Density: 95 percent compaction as determined by ASTMD698.
   b. Moisture content: minus 2 to plus 4 of optimum.

F. Finishing

1. After completing compaction, clip, skin, or tight-blade the surface with a maintainer or subgrade trimmer to a depth of approximately 1/4 inch.
2. Remove loosened material and dispose of it at an approved location.
3. Seal the clipped surface immediately by rolling with an appropriate size pneumatic tire roller until a smooth surface is attained.
4. Add small increments of water as needed during rolling.
5. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades as shown on the Drawings or as directed.
6. In areas where surfacing is to be placed, correct grade deviations greater than 1/4 inch in 16 feet measured longitudinally or greater than 1/4 inch over the entire width of the cross-section.
7. Correct by loosening, adding, or removing material.
8. Reshape and recompact in accordance with 3.4.C.

3.03 QUALITY CONTROL

G. Density Test

1. City to measure density of flexible base course.
   a. Notify City Project Representative when flexible base ready for density testing.
   b. Spacing directed by City (1 per block minimum).
   c. City Project Representative determines location of density testing.

END OF SECTION

SECTION 03 30 53
Concrete Paving

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Portland cement concrete paving.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.03 REFERENCES

A. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
B. ASTM A185 - Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
C. ASTM A497 – Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
D. ASTM A615 - Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
E. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
F. ASTM C 33 - Standard Specifications for Concrete Aggregates.
G. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
H. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
I. ASTM C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
J. ASTM C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading).
K. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
L. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
M. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
N. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
O. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
P. ASTM C 150 - Standard Specification for Portland Cement.
Q. ASTM C 174 - Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
R. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
S. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
T. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

U. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
V. TxDOT Tex-203-F - Sand Equivalent Test.
W. W TxDOT Tex-406-A - Material Finer than 75 □m (No. 200) Sieve In Mineral Aggregates

1.04 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.
B. Submit proposed mix design and test data for each type and strength of concrete in Work.
C. Include proportions and actual flexural strength obtained from design mixes at required test ages.
D. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver, when proposed for use.
E. Submit manufacturer's certificates giving properties of reinforcing steel. Include certificate of compliance with ASTM A 82. Provide specimens for testing when required by Project Manager.

1.05 HANDLING AND STORAGE

A. Do not mix different classes of aggregate without written permission of Project Manager.
B. Class of aggregate being used may be changed before or during Work with written permission of Project Manager. Comply new class with specifications.
C. Reject segregated aggregate. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.
D. Reject aggregates mixed with dirt, weeds, or foreign matter.
E. Do not dump or store aggregate in roadbed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland Cement:

1. Sample and test cement to verify compliance with Standards of ASTM C 150, Type I or Type III.
2. Bulk cement which meets referenced standards may be used when method of handling is approved by Project Manager. When using bulk cement, provide satisfactory weighing devices.
3. Fly ash which meets standards of ASTM C 618 may be used as mineral fill when method of handling is approved by Project Manager.

B. Water: Conform to requirements for water in ASTM C 94.
C. Coarse Aggregate: Crushed stone, gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C 33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).

1. Maximum percentage by weight of deleterious substances shall not exceed following values:

Item	Percent by Weight of Total Sample Maximum
Clay lumps and friable particles	3.0
Material finer than 75-µm (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All Other concrete	5.0*
Coal and lignite:	
Where surface appearance of concrete is of importance	0.5
All other concrete	1.0

* In case of manufactured sand, when material finer than 75-µm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

2. Conform coarse aggregate (size 1 1/2 inch to No. 4 sieve) to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 1 3/4" sieve	0
Retained on 1 1/2"sieve	0 to 5
Retained on 3/4" sieve	30 to 65
Retained on 3/8" sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test *Method Tex-406-A	1.0 maximum

D. In case of aggregates made primarily from crushing of stone, when material finer than 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of TxDOT Tex-406-A, percent may be increased to 1.5.

E. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Conform fine aggregate for concrete to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5

Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

F. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.

G. Mineral Filler: Type “C” or Type “F” fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts to exceed 25 percent by weight of cementatious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, term "cement" is defined as cement plus fly ash.

H. Air Entraining Agent: Furnish air entraining agent conforming to requirements of ASTM C 260.

I. Water Reducer: Water reducing admixture conforming to requirements of ASTM C 494 may be used when required to improve workability of concrete. Amount and type of admixture is subject to approval by Project Manager.

J. Reinforcing Steel:

1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A 615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil, or other injurious materials. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.

K. Provide wire fabric conforming to ASTM A 82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength not to be broken during handling or placing. Conform welding and fabrication of fabric sheets to ASTM A 185.

L. A. Conform Equipment to requirements of ASTM C94.

2.02 MIXING

A. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C78 (using simple beam with third-point loading). Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Determine and measure batch quantity of each ingredient, including water for batch designs and all

concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.

B. Mix design to produce concrete which will have flexural strength of 500 psi at 7 days and 600 psi at 28 days. Minimum compressive strength shall be 3000 pounds per square inches for 7 days and 3500 pounds per square inches at 28 days when tested in accordance with ASTM C39. Slump of concrete shall be at least 2 inches but no more than 5 inches, when tested in accordance with ASTM C143.

C. Concrete pavement, including curb, curb and gutter, and saw-tooth curb, shall contain at least 5 1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water-cement ratio maximum 0.57). Determine cement content in accordance with ASTM C 138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.

D. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4 1/2 percent plus or minus 1 1/2 percent. Determine air content by testing in accordance with ASTM C 231.

E. Use retardant when temperature exceeds 90 degrees F. Proportion as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.

F. Use high early strength concrete pavement to limits shown on Drawings. Design to meet following:

1. Concrete Mix: Flexural strength greater than or equal to 500 psi at 72 hours.
2. Cement: Minimum of 7 sacks of cement per cubic yard of concrete.
3. Water-Cement Ratio maximum of 0.45. Slump of concrete shall a maximum of 5-inches, when tested in accordance with ASTM C 143.
4. Other requirements for proportioning, mixing, execution, testing, etc., shall be in accordance with this Section 03 30 53 - Concrete Paving.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify compacted base is ready to support imposed loads and meets compaction requirements.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.

B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

3.03 EQUIPMENT

A. Alternate equipment and methods, other than those required by this Section, may be used provided equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.

B. Subgrade Planer and Template:

1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form, and have strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.
2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1 foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.

C. Machine Finisher: Provide power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires when it operates on concrete pavement.

D. Hand Finishing:

1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.
2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.

E. Burlap Drag or transverse broom for Finishing Slab: Furnish four plies of 10 ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact 3 foot width of burlap material with pavement surface. Keep burlap drags clean and free of encrusted mortar.

F. Vibrators: Furnish mechanically-operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.

G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Meet

requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship. When traveling form paver does not provide concrete paving that meets compaction, finish, and tolerance requirements of this Specification, immediately discontinue its use and use conventional methods.

1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Use float long enough to extend across pavement to side forms or edge of slab.
2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.
3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace pavement in which tie bars assume final position other than that shown on Drawings.

3.04 FORMS

A. Side Forms: Use metal forms of approved shape and section. Preferred depth of form is equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness when not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Bottom flange of form shall be same size as thickness of pavement. Aluminum forms are not allowed. Forms shall be approved by Project Manager. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200 foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than 8 inches for form 8 inches or more in height. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.

B. Form Setting:

1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of

finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by Project Manager.

2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. Do not use adjacent slabs for forms until concrete has aged at least 7 days.

3.05 REINFORCING STEEL AND JOINT ASSEMBLIES

A. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings.
B. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.
C. Position pavement joint assemblies at required locations and elevations, and rigidly secure in position. Install dowel bars in joint assemblies, each parallel to pavement surface and to center line of pavement, as shown.
D. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.
E. Secure in required position to prevent displacement during placing and finishing of concrete.
F. Drill dowels into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.
G. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

3.06 FIBROUS REINFORCING

A. Do not use fibrous reinforcing to replace structural, load-bearing, or moment-reinforcing steel.

3.07 PLACEMENT

A. Place concrete when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Do not place concrete when temperature is below 40 degrees F and falling.
B. Place concrete within 90 minutes after initial water had been added. Remove and dispose of concrete not placed within this period.
C. Concrete slump during placement shall be 1 to 5 inches, except when using traveling-form paver, slump shall be maximum of 2 inches.
D. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling

concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10 feet long.

E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

3.08 COMPACTION

A. Consolidate concrete using mechanical vibrators as specified herein. Extend vibratory unit across pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete

B. along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.09 FINISHING

A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.

B. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement section shown on Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

C. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template.

D. Use longitudinal float to level surface.

E. After completion of straightedge operation, make first pass of burlap drag or transverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth.

F. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

3.10 JOINTS AND JOINT SEALING

A. Conform to requirements of Section 32 13 73 - Concrete Pavement Joints.

3.11 CONCRETE CURING

A. Conform to requirements of Section 32 13 77 - Concrete Pavement Curing.

3.12 TOLERANCES

A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10 foot straightedge parallel to center of roadway to bridge depressions and touch high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10 foot straightedge shall not exceed 1/8 inch. Grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

3.13 FIELD QUALITY CONTROL

A. Perform testing under provisions of Section 01 45 23 - Testing Laboratory Services.
B. Compressive Strength Test Specimens: Make four test specimens for compressive strength test in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Test two specimens at 7 days or at number of hours as directed by the Project Manager for high early strength concrete. Test remaining two specimens at 28 days.
C. Test specimens in accordance with ASTM C 39. Minimum compressive strength shall be 3000 pounds per square inch for first two specimens and 3500 pounds per square inch at 28 days.
D. When compressive test indicates failure, make yield test in accordance with ASTM C 138 for cement content per cubic yard of concrete. When cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.
E. Minimum of one 4 inch core will be taken at random locations per 375 feet per 12 feet lane or 500 square yards of pavement to measure in-place depth. Measure depth in accordance with ASTM C 174. Each core may be tested for 28 day compressive strength according to methods of ASTM C 42. 28 day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.
F. Request, at option, three additional cores in vicinity of cores indicating nonconforming in-place depths at no cost to City. In-place depth at these locations shall be average depth of four cores.
G. Fill cores and density test sections with new concrete paving or non shrink grout.

3.14 NONCONFORMING PAVEMENT

A. Remove and replace areas of pavement found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with concrete of thickness shown on Drawings.
B. When measurement of any core is less than specified thickness by more than 10 percent, actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to centerline in each direction from deficient core until, in each direction, core is taken which is not deficient by more than 10 percent. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine length of pavement in unit that is to be removed and replaced.
C. Replace nonconforming pavement sections at no additional cost to City.

3.15 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price.
2. Apply adjustment to lower limit of 90 percent and upper limit of 100 percent of unit price.
3. Average depth below 90 percent but greater than 80 percent may be accepted by Project Manager at adjusted Unit Price of:
4. Unit Price Bid - [2 x (1-ratio) x Unit Price Bid]
5. Ratio equals average core thickness divided by thickness bid upon
6. 0.9 ratio pays 80 percent of unit price and 0.8 ratio pays 60 percent of unit price.
7. Average depth below 80 percent will be rejected by Project Manager.

3.16 PAVEMENT MARKINGS

A. Restore pavement markings to match those existing in accordance with City of League City standard specifications and details and Project Manager's requirements.

3.17 PROTECTION

A. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricade pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old. Pavement may be open to traffic earlier provided Contractor pays for testing and additional specimen once 7 day specified strength is obtained. Pavement may be opened when high early strength concrete is used meeting specified 72 hour strength.
B. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by Project Manager.
C. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by traffic. Opening of pavement to traffic shall not relieve responsibility for Work.
D. Maintain concrete paving in good condition until completion of Work.
E. Repair defects by replacing concrete to full depth.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 32 13 73
Concrete Pavement Joints

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.
B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.
B. Payment for street pavement expansion joints, with or without load transfer, is on linear foot basis.
C. Payment for horizontal dowels is on a unit price basis for each horizontal dowel.
D. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.
E. No separate payment will be made for joints for Curb, Curb and Gutter, Saw-tooth Curb, Concrete Sidewalks, and Concrete Driveways. Include payment in unit price for Curb and Gutter, Concrete Sidewalks, and Concrete Driveways.
F. Payment will be made for Preformed Expansion Joints on a linear foot basis only when field conditions require that sidewalk be moved adjacent to existing concrete structure (i.e., street, back of curb, etc.).
G. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.
H. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.
E. TxDOT Tex-525-C - Tests for Asphalt and Concrete Joint Sealers

1.04 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.
B. Submit product data for joint sealing compound and proposed sealing equipment for approval. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

PART 2 - PROIDUCTS

2.01 BOARD EXPANSION JOINT MATERIAL

A. Filler board of selected stock. Use wood of density and type as follows:
B. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
C. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

2.02 PREFORMED EXPANSION JOINT MATERIAL

A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

2.03 JOINT SEALING COMPOUND

A. Conform joint sealants to one of sealant classes described in this section.
B. Conform hot-poured rubber-asphalt compound to ASTM D 3405.
C. Two-component Synthetic Polymer.
D. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles.
E. Cure sufficiently at average temperature of 25 ± 1 C (77 ± 2 F) so as not to pick up under wheels of traffic in maximum three hours.
F. Performance requirements, when tested in accordance with TxDOT Tex-525-C, shall meet above curing times and requirements as follows:

Cold-Extruded and Cold-Pourable (Self-Leveling) Specifications	
Property	Requirement
Penetration, 25 C (77 F) 150 g Cone, 5 s, 0.1 mm (in.), maximum	130
Bond and Extension 50%, -29 C (-20 F), 3 cycles: *Dry Concrete Block *Steel blocks (Primed, if recommended by manufacturer) *Steel blocks shall be used when armor joints are specified	Pass Pass
Flow at 70 C (158 F)	None
Water content % by mass, maximum	5.0
Resilience: Original sample, % min. (cured) * Oven-aged at 70 C (158 F), % min.	 50 50
Cold-extruded material only - Cold Flow (10 minutes)	None

1. After bond and extension test, there shall be no evidence of cracking, separation or other opening that is over 3 millimeters (1/8 inch) deep in sealer or between sealer and test blocks.
2. Provide cold-extruded type for vertical or sloping joints.
3. Provide self-leveling type for horizontal joints.

G. Self-Leveling, Low Modulus Silicone or Polyurethane Sealant for Asphaltic Concrete and Portland Cement Concrete Joints. This shall be a single component self-leveling silicone or polyurethane material that is compatible with both asphalt and concrete pavements. The sealer shall not require a primer for bond; a backer rod shall be required which is compatible with the sealant; no reaction shall occur between rod and sealant.

H. When tested in accordance with TxDOT Tex-525-C, self-leveling sealant shall meet the following requirements:

Self-Leveling, Low Modulus Silicone or Polyurethane Sealant	
Property	Requirements
Tack Free Time, 25 ± 1 C (77 ± 2 F), minutes	120 maximum
Nonvolatile content, % by mass	93 minimum
Tensile Strength and 24 Hour Extension Test: * Initial, 10-day cure, 25 ± 1 C (77 ± 2 F), kPa (psi) * After Water Immersion, kPa (psi) * After Heat Aging, kPa (psi) * After Cycling, -29 C (-20 F), 50%, 3 cycles, kPa (psi) * 24 Hour Extension	* 21 to 69 (3 to 10) * 21 to 69 (3 to 10) * 21 to 69 (3 to 10) * 21 to 69 (3 to 10) * Pass (All Specimens) After 24 hours, there shall be no evidence of cracking, separation or other opening that is over 3 mm (1/8 in.) deep at any point in the sealer or between the sealer and test blocks.

2.04 LOAD TRANSMISSION DEVICES

A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

2.05 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Project Manager.

PART 3 - EXECUTION

3.01 PLACEMENT

A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

3.02 CONSTRUCTION JOINTS

A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.03 EXPANSION JOINTS

A. Place 3/4 inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device." Seal with joint sealing compound.

3.04 CONTRACTION JOINTS

A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.05 LONGITUDINAL WEAKENED PLANE JOINTS

A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

3.06 SAWED JOINTS

A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of 1/4 inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

3.07 JOINTS FOR CURB, CURB AND GUTTER

A. Place 3/4 inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

3.08 JOINTS FOR CONCRETE SIDEWALKS

A. Provide 3/4 inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D 994 for small radius curves and around fire hydrants and utility poles. Extend expansion joint material full depth of slab.

3.09 JOINTS FOR CONCRETE DRIVEWAYS

A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

3.10 JOINT SEALING

A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.
B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by Project Manager. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.
C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural.
D. Remove loose material from concrete surfaces adjacent to joints.
E. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

3.11 PROTECTION

A. Maintain joints in good condition until completion of Work.
B. Replace damaged joints material with new material as required by this Section.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 32 13 77
Concrete Pavement Curing

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Curing of Portland cement concrete paving.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.
B. No separate payment will be made for concrete curing under this Section. Include payment in unit price for Concrete Paving, Concrete Sidewalks, Concrete Driveways, Curbs, and Curb and Gutters.
C. Refer to Section 01 20 00 - Measurement and Payment for unit price procedures.
D. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM C 156 - Standard Test Method for Water Retention by Concrete Curing Materials.
B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
C. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

1.04 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.
B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds.

PART 2 - PRODUCTS

2.01 COVER MATERIALS FOR CURING

A. Conform curing materials to one of the following:

1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C 171.

B. Waterproofed Paper: Paper conforming to requirements of ASTM C 171. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth.
C. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Stitch mats so that mat will contact surface of pavement at all points when saturated with water.

2.02 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Conform liquid membrane-forming compounds to ASTM C 309. Membrane shall restrict loss of water to not more than 0.55 kg/m2 in 72 hours using test method ASTM C 156.

PART 3 - EXECUTION

3.01 CURING REQUIREMENT

A. Cure concrete pavement by protecting against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphalt concrete.
B. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.02 POLYETHYLENE FILM CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.
B. Cover entire surface and both edges of pavement slab. Overlap joints in film sheets minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or replacing.

3.03 WATERPROOFED PAPER CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.
B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Overlap joints in blankets caused by joining paper sheets not less than 5 inches and securely seal with asphalt cement having melting point of approximately 180 degrees F. Place blankets to secure overlap of at least 12 inches. Immediately repair tears or holes appearing in paper during curing period by cementing patches over defects.

3.04 COTTON MAT CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, maintaining contact with surface of pavement equally at all points.
B. Keep mats on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

3.05 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Immediately after free surface moisture, and after concrete has dispersed, apply liquid membrane-forming compound in accordance with manufacturer's instructions.

B. Moisten concrete by water fogging prior to application of membrane when surface has become dry.

C. Seal concrete surface with single coat at rate of coverage recommended by manufacturer and directed by Project Manager, but not less than one gallon per 200 square feet of surface area.

3.06 TESTING MEMBRANE

A. Treated areas will be visually inspected for areas of lighter color of dry concrete as compared to dump concrete. Test suspected areas by placing few drops of water on surface. Membrane passes test when water stands in rounded beads or small pools which can be blown along surface of concrete without wetting surface. Reapply membrane compound immediately at no cost to City when membrane fails above test.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 32 16 00

CURBS, GUTTERS, SIDEWALKS, AND DRIVEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Curbs
2. Gutters
3. Sidewalks
4. Curb Ramps
5. Driveways

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

B. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.3 REFERENCES

A. Abbreviations and Acronyms

1. TAS – Texas Accessibility Standards
2. TDLR – Texas Department of Licensing and Regulation

B. Definitions

1. Curb: concrete edging or barrier measuring 18” or less in maximum height.

C. Reference Standards

1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
2. Texas Manual on Uniform Traffic Control Devices (TMUTCD).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Construction Meeting

a. Hold a pre-construction meeting in accordance with Sections 32 12 16 and 32 13 13.

B. Sequencing

1. Sidewalk Construction
   a. Where existing sidewalks are to be closed during Curb, Gutter, Sidewalk, and Driveway activities:
      1) Utilize pedestrian/sidewalk detour route specified in the Drawings
         a) If no detour route is provided, submit a pedestrian/sidewalk detour route to City for review.

2) The pedestrian/sidewalk detour route will be subsidiary to pertinent Traffic Control items included with the project.

b. Install all sidewalk detours and closures in accordance with the TMUTCD, State, and local guidelines.

c. Provide any traffic control devices as required by the City.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Concrete Mix Design in accordance with Section 03 00 00.

B. Asphalt Mix Design in accordance with Section 32 12 16.

C. Product Data

1. Provide the following from each manufacturer supplying the following in accordance with Sections 03 00 00 and 32 12 16:
   a. Curing compounds
   b. Evaporation retardant
   c. Joint fillers
   d. Chemical additives
   e. Epoxy
   f. Fiber reinforcing

D. Equipment Submittals

1. Submit an equipment list of all major equipment in accordance with Sections 32 12 16 and 32 13 13.

E. Test and Evaluation Reports

1. Provide testing and evaluation reports in accordance with Sections 01 45 23, 03 00 00, 32 12 16, and 32 13 13.

1.7 CLOSEOUT SUBMITTALS

A. Test and Evaluation Reports

1. All test reports generated during testing.

B. TDLR Inspection

1. Submit TDLR Proof of Inspection. Remove and replace any portions found to be failing in accordance with Article 3.7.

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements

1. Secure and maintain a location to store the material in accordance with Section 01 66 00.

B. Follow all delivery, storage, and handling requirements for asphalt and concrete in Sections 03 00 00, 32 12 16, and 32 13 13.

1.11 FIELD CONDITIONS

A. Follow all field condition requirements for asphalt and concrete in accordance with Sections 03 00 00, 32 12 16, and 32 13 13.

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-FURNISHED PRODUCTS [NOT USED]

2.2 MATERIALS

A. Refer to City standard details and Section 31 23 16 and 31 24 00 for requirements for excavation and backfill.

B. Concrete
   1. Provide Class A in accordance with Section 03 00 00.
   2. Production Materials
      a. Provide cementitious materials, admixtures, water, forms, joint filler, joint sealant, and reinforcing chairs in accordance with Section 32 13 13.
   3. Aggregate:
      a. Provide aggregate in accordance with Section 03 00 00 and 32 05 16.
      b. Use coarse aggregate that is no larger than 1-1/2 inch.
   4. Reinforcement:
      a. Curb
         1) When constructing Concrete Curb, Concrete Curb and Gutter, Concrete Valley Gutter, or Concrete Ribbon Curb use fiber reinforcing in accordance with Section 03 00 00.
         2) When constructing Concrete Curb (Monolithic) use reinforcing steel in accordance with Section 03 00 00.
      b. Sidewalk and Curb Ramps
         1) When constructing sidewalk less than 6” in thickness use fiber reinforcement in accordance with Section 03 00 00.
         2) When constructing sidewalk 6” in thickness or greater use steel reinforcement in accordance with Section 03 00 00.
      c. Driveway and Driveway Approaches
         1) Provide reinforcing steel in accordance with Section 03 00 00.

C. Asphalt
   1. Refer to Section 32 12 16 for material requirements.
   2. Use Type D for Asphalt Driveway surface courses.
   3. Use Type B for Asphalt Driveway intermediate and/or base courses.

D. Curb Ramps
   1. Provide detectable warning surface in accordance with TAS.

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL

A. Follow all source quality control requirements for asphalt and concrete in Sections 03 00 00, 32 12 16, and 32 13 13.

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION

A. Surface Preparation
   1. Excavate and remove materials as required for the construction of curbs, sidewalks, and driveways in accordance with Sections 02 41 15, 31 10 00, and 31 23 16.
   2. Shape and compact subgrade or foundation surface to the line, grade, and cross-section specified in the Drawings.
   3. If required, treat subgrade in accordance with Sections 32 11 29 and 32 11 33.
   4. Lightly sprinkle subgrade or foundation surface immediately before final concrete or asphalt placement.

3.4 INSTALLATION

A. General
   1. Provide finished work with a well-compacted mass and a surface free from voids meeting the required shape, line, and grade as specified in the Drawings.
   2. Place concrete and asphalt in accordance with Sections 32 12 16 and 32 13 13.
   3. All pedestrian facilities shall comply with provisions of TAS including location, slope, width, shapes, texture and coloring. Pedestrian facilities installed by the Contractor and not meeting TAS must be removed and replaced to meet TAS at no cost to the City.

B. Equipment
   1. Use equipment in accordance with Section 32 12 16 and 32 13 13.
   2. Smart level:
      a. Use approved Smart Level to verify all sidewalk, curb ramp, and driveway grades.
      b. Calibrate Smart Level with City inspector prior to performing tests.

C. Curbs
   1. Integral
      a. Place integral curb while the pavement is still plastic.
      b. Spade and consolidate concrete material with pavement in order to obtain a thorough bond.
   2. Formed
      a. Extend forms to full depth of concrete.

b. Pour concrete into forms and strike off with a template 1/4 to 3/8 in. less than the dimensions of the finished curb.
c. When removing forms, take caution to prevent marring or spalling or concrete.
d. After initial set, plaster surface with mortar consisting of 1 part hydraulic cement and 2 parts fine aggregate.
e. Brush exposed surfaces to a uniform texture.

3. Slip-formed
   a. Hand-tamp and sprinkle subgrade material before concrete placement.
   b. Provide clean surfaces for concrete placement.
   c. Place the concrete with approved self-propelled equipment.
      1) The forming tube of the extrusion machine or the form of the slip form machine must easily be adjustable vertically during the forward motion of the machine to provide variable heights required to maintain established grade line.
   d. Attach a pointer or gauge to the machine so a continual comparison can be made between the extruded or slip form work and grade guideline.
   e. Brush finish surfaces immediately after extrusion or slip forming.

4. Joints
   a. Place expansion joints in the curb and gutter at 200-foot intervals and at intersection returns and other rigid structures.
   b. Place tooled joints at 15-foot intervals or matching abutting sidewalk joints and pavement joints to a depth of 1-1/2 inches.
   c. Place expansion joints at all intersections with concrete driveways, curbs, buildings, and other curb and gutters.
   d. Make expansion joints no less than 1/2 inch in thickness, extending the full depth of the concrete.
   e. Make expansion joints perpendicular and at right angles to the face of the curb.
   f. Neatly trim any expansion material extending above the finished work down to finished grade.
   g. Make expansion joints in the curb and gutter coincide with concrete expansion joints.
   h. Longitudinal dowels across the expansion joints in the curb and gutter are required.
   i. Install 3 No. 4 round, smooth bars, 24 inches in length, for dowels at each expansion joint.
   j. Coat 1/2 of the dowel with a bond breaker and terminate with dowel cap.
      1) Dowel cap required to provide a minimum of 1 inch free expansion.
   k. Support dowels by an approved method.

D. Sidewalk
   1. Sidewalks constructed in driveway approach sections shall have a minimum thickness equal to that of driveway approach or as specified in the Drawings.
   2. Terminate workday production at an expansion joint.
   3. Formed
      a. Provide pre-molded or board expansion joints of the thickness specified in the Drawings for sidewalk section lengths greater than 8 feet but less than 40 feet.
   4. Slip-formed
      a. Provide any additional surface finishing immediately after extrusion of slip-forming.
      b. Construct joints at locations as specified in the Drawings.

5. Joints
    a. Place expansion joints at 40 foot intervals.
    b. Place expansion joints at sidewalks with concrete driveways, intersections with other sidewalks, and at other adjacent old concrete work.
    c. All expansion joints shall be 1/2 inch in thickness.
    d. Edges of all construction and expansion joints and outer edges of all sidewalks shall be finished to approximately a 1/2 inch radius with a suitable finishing tool.
    e. Sidewalks shall be marked at intervals equal to the width of the walk with a marking tool.
    f. When sidewalk is against the curb, expansion joints shall match those in the curb.

E. Curb Ramps
    1. Install detectable warning surface according to manufacturer's instructions.

F. Driveways
    1. Provide concrete driveways and driveway approaches unless specified otherwise.
    2. Provide uninterrupted access to adjacent property unless otherwise directed.
    3. When curb is required, construct monolithically with the driveway pavement.

3.5 REPAIR [NOT USED]

3.6 RE-INSTALLATION [NOT USED]

3.7 SITE QUALITY CONTROL

A. Concrete Placement Acceptance
    1. Follow all acceptance requirements in accordance with Sections 03 00 00 and 32 13 13.

B. Asphalt Placement Acceptance
    1. Follow all acceptance requirements in accordance with Sections 03 00 00 and 32 12 16.

C. Non-conforming work
    1. Any work found to be non-conforming to the Contract Documents will be removed and replaced at Contractor's expense.
    2. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pavement Markings:
   a. Thermoplastic, hot-applied, spray (HAS) pavement markings
   b. Thermoplastic, hot-applied, extruded (HAE) pavement markings
   c. Preformed retroreflective polymer pavement markings tape
   d. Reflectorized multipolymer, spray pavement markings
   e. Preformed heat-activated thermoplastic tape
   f. Pavement markings, paint
2. Pavement Marking Legends.
3. Raised Pavement Markers.
4. Work Zone Markings.
5. Removal of Pavement Markings and Markers.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

B. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.
   a. The price bid shall include:
      1) Furnishing and installing pavement markings
      2) Hauling
      3) Disposal of excess materials
      4) Clean-up

1.3 REFERENCES

A. Reference Standards

1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
2. Texas Manual on Uniform Traffic Control Devices (TMUTCD), 2011 Edition:
   a. Part 3, Markings.
3. Federal Highway Administration (FHWA):
   a. 23 CFR Part 655, FHWA Docket No. FHWA-2009-0139.
4. Texas Department of Transportation (TxDOT) Departmental Material Specifications (DMS):
   a. 4200, Pavement Markers (Reflectorized).
   b. 4300, Traffic Buttons.

c. 8200, Traffic Paint.
d. 8220, Hot Applied Thermoplastic.
e. 8240, Permanent Prefabricated Pavement Markings.
f. 8241, Removable Prefabricated Pavement Markings.
g. 8242, Temporary Flexible-Reflective Road Marker Tabs.
h. 8290, Glass Traffic Beads.

5. Texas Department of Transportation (TxDOT) Pavement Marking Handbook:
   a. Special Specification 1513 – Reflectorized Multipolymer Pavement Markings- Houston District.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery and /or fabrication for special.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements
   1. Secure and maintain a location to store the material in accordance with Section 01 66 00.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers
   1. Pavement Markings
      a. Preformed Retroreflective Polymer Pavement Markings Tape
         1) Provide in accordance with Standard Product List or approved equal.
   2. Substitution requests for manufacturers or models not indicated above shall be processed in accordance with Section 01 25 00.

B. Materials
   1. Pavement Markings
      a. Thermoplastic, hot applied, spray
         1) Width of longitudinal lines as specified in Drawings.
         2) Supply products especially compounded for traffic markings.
         3) When placed on driving surfaces, markings shall not be slippery when wet, lift from pavement under normal weather conditions, nor exhibit a tacky exposed surface.
         4) Cold ductility of the material shall permit normal road surface expansion and contraction without chipping or cracking.
         5) Retain original color, dimensions, and placement under normal traffic conditions at road surface temperatures of 158 degrees Fahrenheit and below.
         6) Uniform cross-section, clean edges, square ends, and no evidence of tracking.
         7) Density, quality, and thickness of the material shall be uniform throughout the length and width of the markings.

8) 95 percent free of holes and voids, and free of blisters for a minimum of 60 days after application.
9) Material shall not deteriorate by contact with sodium chloride, calcium chloride or other chemicals used to prevent roadway ice, because of the oil content of pavement markings, from oil droppings, or other effects of traffic.
10) Material shall not prohibit adhesion of other thermoplastic markings if, at some future time, new markings are placed over existing material.
    a) New material shall bond itself to the old marking in such a manner that no splitting or separation takes place.
11) Markings placed on driving surfaces shall be completely retroreflective both internally and externally with traffic beads and shall exhibit uniform retro-directive reflectance.

b. Thermoplastic, hot applied, extruded
1) Supply products especially compounded for traffic markings
2) When placed on driving surfaces, markings shall not be slippery when wet, lift from pavement under normal weather conditions nor exhibit a tacky exposed surface.
3) Cold ductility of the material shall permit normal road surface expansion and contraction without chipping or cracking.
4) Markings shall retain their original color, dimensions, and placement under normal traffic conditions at road surface temperatures of 158 degrees Fahrenheit and below.
5) Markings shall have uniform cross-section, clean edges, square ends, and no evidence of tracking.
6) Density, quality, and thickness of the material shall be uniform throughout the length and width of the markings.
7) 95 percent free of holes and voids, and free of blisters for a minimum of 60 days after application
8) Minimum thickness of the marking, as measured above the plane formed by the pavement surface, shall not be less than 1/8 inch in the center of the marking and 3/32 inch at a distance of 1/2 inch from the edge.
9) Maximum thickness shall be 3/16 inch.
10) Material shall not deteriorate by contact with sodium chloride, calcium chloride, or other chemicals used to prevent roadway ice or because of the oil content of pavement markings or from oil droppings or other effects of traffic.
11) Material shall not prohibit adhesion of other thermoplastic markings if, at some future time, new markings are placed over existing material.
    a) New material shall bond itself to the old marking in such a manner that no splitting or separation takes place.
12) Markings placed on the roadway shall be completely retroreflective both internally and externally with traffic beads and shall exhibit uniform retro-directive reflectance.

c. Glass traffic beads
1) Manufactured from glass
2) Spherical in shape
3) Essentially free of sharp angular particles

4) Essentially free of particles showing cloudiness, surface scoring or surface scratching
5) Water white in color
6) Applied at a uniform rate
7) In accordance with requirements of DMS-8290

d. Reflectorized Multipolymer, spray Pavement Markings Tape
1) Material in accordance with TxDOT Special Specification 1513.

2. Preformed Heat-Activated Thermoplastic Tape
1) HotTape preformed thermoplastic
a) 0.125 mil thickness

b. Pavement Markings, Paint
1) In accordance with DMS-8200.

3. Raised Pavement Markers
a. In accordance with the requirements of the TMUTCD.
b. Non-reflective markers:
1) Round Ceramic Marker Types
a) Type Y (yellow body)
b) Type W (white body)
2) In accordance with DMS-4300
c. Reflective markers:
1) Manufactured of plastic
2) In accordance with DMS-4200
3) Marker Types:
a) Type I-C, white body, 1 face reflects white
b) Type II-A-A, yellow body, 2 faces reflect amber
c) Type II-C-R, white body, 1 face reflects white, the other red

4. Work Zone Markings
a. Temporary Flexible-Reflective Roadway Marker Tabs
1) In accordance with DMS-8242
2) Do not use to simulate edge lines.
3) No segment of roadway open to traffic shall remain without permanent pavement markings for a period greater than 14 calendar days.
b. Raised Pavement Markers
1) In accordance with DMS-4200
c. Striping
1) In accordance with DMS-8200

2.2 ACCESSORIES [NOT USED]

2.3 SOURCE QUALITY CONTROL

A. Performance
1. Maintain minimum retro reflectivity level for longitudinal markings as detailed below for a minimum of 30 calendar days.

	Posted Speed (mph)

	≤ 30	35 – 50	≥ 55
2-lane roads with centerline markings only [1]	n/a	100	250
All other roads [2]	n/a	50	100

[1] Measured at standard 30-m geometry in units of mcd/m^2/lux.

[2] Exceptions:

A. When raised reflective pavement markings (RRPMs) supplement or substitute for a longitudinal line, minimum pavement marking retroreflectivity levels are not applicable as long as the RRPMs are maintained so that at least 3 are visible from any position along that line during nighttime conditions.
B. When continuous roadway lighting assures that the markings are visible, minimum pavement marking retro reflectivity levels are not applicable.

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION

A. Surface Preparation
   1. Remove dirt, grease, loose and/or flaking existing markings, and other forms of contamination from existing roadway surface.
   2. Remove curing membrane from new concrete surfaces.
   3. Apply material after pavement surface is completely dry.
      a. The pavement is considered dry if there is no condensation after 15 minutes of observation on the underside of 1 square foot piece of clear plastic placed on pavement surface and weighted on the edges on a sunny day.
   4. Equipment and methods used for surface preparation shall not damage existing pavement or create a hazard to motorists or pedestrians.

3.4 INSTALLATION

A. General
   1. Apply materials in accordance with the manufacturer's recommendations.
   2. Apply markings and markers on clean, dry pavement with a surface temperature above 50 degrees Fahrenheit and/or within temperature limits recommended by the material manufacturer.
   3. Ensure proper safety precautions and traffic control when markings are applied on roadways open to traffic. Provide traffic control in accordance with TMUTCD.
   4. Protect freshly applied markings from traffic damage and disfigurement.
   5. Temperature of the material must be equal to the temperature of the road surface prior to restoring traffic.

B. Pavement Markings
   1. Thermoplastic, hot applied, spray

a. For installation and replacement of long lines – centerlines, lane lines, edge lines, turn lanes, and dots.
b. Application Thickness:
    1) 100 mils
        a) For applications over existing markings, install 90 mils.
c. Use sealer on concrete or asphalt pavement older than three (3) years.
d. Provide a typical setting time between 4 minutes and 10 minutes depending upon the roadway surface temperature and the humidity factor.
e. Supplement roadway centerlines, lane lines, and turn lanes with retroreflective raised pavement markers. Place markers as specified in the Drawings.

2. Thermoplastic, hot applied, extruded
    a. For installation and replacement of crosswalks and stop-lines.
    b. Apply markings at a 125 mil thickness.
3. Preformed Polymer Tape
    a. For installation and replacement of crosswalks, stop-lines, and legends.
    b. Apply markings to adhere to the pavement surface with no slippage or lifting and have square ends, straight lines, and clean edges.
4. Preformed Heat-Activated Thermoplastic Tape
    a. For installation and replacement of crosswalks, stop-lines, and legends.
    b. Apply marking to adhere to the pavement surface with no slippage or lifting and have square ends, straight lines, and clean edges.

C. Raised Pavement Markers
1. Install on concrete roadways with epoxy adhesive.
    a. Bituminous adhesive is not permitted.
2. Install on new asphalt roadways with epoxy or bituminous adhesive.
3. Ensure proper alignment of individual marker using a chalk line, chain, or equivalent. Place markers uniformly along the line to achieve a smooth continuous appearance.

D. Work Zone Markings
1. Minimize disruption to traffic.
2. Install longitudinal markings on pavement surfaces before opening to traffic.
3. Maintain lane alignment traffic control devices and operations until markings are installed.
4. Install markings in proper alignment in accordance with the TMUTCD and as specified in the Drawings.
5. Place standard longitudinal lines no sooner than 3 calendar days after the placement of a surface treatment, unless otherwise specified in the Drawings.
6. Place in proper alignment with the location of the final pavement markings.
7. Do not use raised pavement markers for words, symbols, shapes, or diagonal or transverse lines.
8. Marking visibility is required for at least a distance of 300 feet in daylight conditions and 160 feet in nighttime conditions on a low-beam automobile headlight illumination.
9. The daytime and nighttime reflected color of the markings must be distinctly white or yellow.

10. The markings must exhibit uniform retroreflective characteristics.
11. Epoxy adhesives are not permitted for work zone markings

E. Removals
   1. Pavement Marking and Pavement Marker Removal
      a. Use best practices to remove existing pavement markings and markers.
      b. If the roadway is damaged during marker removal, coordinate with the City prior to continuing removal operations.
      c. Minimize color and texture contrast of the pavement surface as a result of removals.
      d. Repair damages greater than ¼ inch in depth resulting from the removal of pavement markings and markers from asphaltic surfaces.
         1) Driveway patch asphalt emulsion may be broom applied to reseal damage to asphaltic surfaces.
      e. Dispose of markers in accordance with Federal, State, and local regulations.
      f. Use any of the following methods unless otherwise specified in the Drawings.
         1) Surface Treatment Method
            a) Apply surface treatment at rates specified in the Drawings.
            b) Place a surface treatment a minimum of 2 feet wide to cover the existing marking.
            c) Place a surface treatment, thin overlay, or microsurfacing a minimum of 1 lane in width in areas where directional changes of traffic are involved or in other areas as directed by the City.
         2) Burn Method
            a) Use burning method approved by City.
            b) For thermoplastic pavement markings or prefabricated pavement markings, heat may be applied to remove the bulk of the marking material prior to blast cleaning.
            c) When using heat, avoid spalling pavement surfaces.
            d) Sweeping or light blast cleaning may be used to remove minor residue.
         3) Blasting Method
            a) Use a blasting method such as water blasting, abrasive blasting, water abrasive blasting, shot blasting, slurry blasting, water-injected abrasive blasting, or brush blasting as approved by City.
            b) Remove pavement markings on concrete surfaces by blasting method only.
         4) Mechanical Method
            a) Use any mechanical method except grinding.
            b) Flail milling is acceptable in the removal of markings on asphalt and concrete surfaces.
   2. No additional compensation will be allowed for removing markings and markers at the location to be paved over or where pavement is to be removed.

3.5 REPAIR [NOT USED]

3.6 RE-INSTALLATION

A. Remove and replace markings placed by faulty application methods or in the wrong position or alignment by the Contractor at the Contractor's expense.

B. Replace or remedy faulty markings on the same day of notification if markings create motorist confusion or hazard, as determined by City. Replace and remedy all other faulty markings within 5 days of notification.

3.7 FIELD QUALITY CONTROL

A. Maintain uniform cross-section with clean edge and square ends for all markings.

B. Maintain uniform density and quality of markings throughout its thickness.

C. More than 5 percent, by area, of holes or voids on the applied markings is not acceptable. Applied markings shall be free of blisters.

END OF SECTION

SECTION 32 31 01
Existing Fencing and Gates

PART 1 - GENERAL

1.01 DESCRIPTION.

A. This Item shall govern for the removal of existing fencing and gates and their disposal, salvaging or reinstallation at a location as shown on the drawings or directed by the Engineer.

PART 2 - MATERIAL

2.01 NOT USED

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. Fencing which is designated to be removed but not reinstalled shall be removed from the site and disposed of by the Contractor in compliance with current local, State and Federal Regulations unless salvaged as directed by the Engineer. All holes left as a result of post removal, if in an area not to receive roadway construction, excavation or fill, shall be filled and tamped with dirt to the elevation of natural ground. The Contractor shall provide the dirt.

B. At such locations where new fencing is to be installed and existing fencing removed, the existing fence shall not be removed until after new fencing has been installed.

C. When a chain link fence is to be reinstalled it shall be installed in accordance with the Item 555 "Chain Link Fencing". When barbed wire fence is to be reinstalled, it shall be installed in accordance with the Item 556 "Four Strand Barbed Wire Fence". When wood fencing is to be reinstalled, it shall be installed in accordance with the Item 554 "Wood Fencing". When an existing fence is to be reinstalled, it shall be installed with the same material, post spacing as the original, and design, or as otherwise directed by the Engineer.

D. If a chain link fence is to be reinstalled, the reinstallation of pig rings and wire clips shall be accomplished with new galvanized or aluminum rings and clips.

E. All new gates shall be as shown on the plans, or as directed by the Engineer.

3.02 MEASUREMENT

A. Measurement for the:

1. A. Removal and Disposal
2. B. Removal and Salvage
3. Removal and Reinstallation of existing fencing shall be made by the linear foot, including gates.

3.03 PAYMENT

A. Payment shall be made at the contract unit price bid per linear foot by type of fencing, including gates:

1. To be removed and disposed of;
2. To be removed and salvaged;
3. To be removed and reinstalled;

B. and this unit price shall include furnishing and installing, all labor, equipment, and any new materials necessary for; removal and disposal, removal and salvaging and/or reinstallation, necessary to complete the work.

END OF SECTION

SECTION 32 31 13
Chain Link Fencing and Signs

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Item shall govern for furnishing and installing the quantities of chain link fencing and gates as shown on the plans, including all posts, bracing and accessories as called for herein and the installation of all items, complete in every respect at the locations shown on the plans.

B. Furnish all labor, materials, equipment, and incidentals required to install signage as shown, as scheduled and specified herein. Types to be furnished are as follows: Restrictive/Caution Signs and Hazard Identification Signs.

1.02 SUBMITTAL REQUIRED

A. The Contractor shall submit manufacturer's certification that materials meet the requirements of this Item.

B. Submit sign layouts for review as follows: Scale layout of all exterior building signs.

1.03 REFERENCES

A. National Fire Protection Association (NFPA)

1. NFPA 49 - Hazardous Chemicals Data
2. NFPA 325M - Properties of Flammable Liquid, Gases, and Volatile Solids
3. NFPA 704 - Identification of Fire Hazards of Materials

B. Occupational Safety and Health Act (OSHA)

1.04 MEASUREMENT

A. Chain link fencing of the height specified, will be measured by the linear foot of fence measured at the bottom of the fabric along the centerline of fence from center to center of end posts, excluding gates. Gates will be measured as each gate, complete in place.

1.05 PAYMENT

A. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

PART 2 - PRODUCTS

2.01 FENCE MATERIALS

A. Wire fabric for fencing shall be 9 gauge steel with a minimum tensile strength of 80,000 psi. Mesh size shall be 2 inch + 1/16 inch between parallel wires. Top edge of fabric shall be twisted and barbed on 5 and 6 foot height fencing and shall be knuckled selvage on 4 foot fencing. Bottom edge of all fencing shall be twisted and barbed.

B. Fabric ties of the same material as fabric shall be furnished in sufficient quantity to fasten fabric to top tension wire or to top rail at 18 inch intervals. Ties shall be furnished to fasten

the fabric to bottom tension wire at 18 inch intervals. The fabric shall be tied to the line posts at 15 inch intervals.

C. Line posts shall be furnished in sufficient quantity to provide a maximum spacing between posts of 10 feet.

TABLE 1
LINE POST REQUIREMENTS

Fabric Height	Pipe Section		H-Beam Section Wt./Ft.	EMBEDMENT LENGTH
	Size	Wt./Ft.		
4 Feet	1.90" O.D.	2.72 lbs.	2.70 lbs.	24"
5 Feet	2.375" O.D.	3.65 lbs.	2.70 lbs.	24"
6 Feet	2.375" O.D.	3.65 lbs.	4.10 lbs.	24"

TABLE 2
CORNER POST, PULL POST AND ENDPOST REQUIREMENTS

Fabric Height	Pipe Section		Embedment Length
	Size	Wt/Ft.	
4 Feet	2.375" O.D.	3.65 lbs.	30"
5 Feet	2.875" O.D.	5.79 lbs.	36"
6 Feet	2.875" O.D.	5.79 lbs.	36"

TABLE 3
GATE POSTS

FABRIC HEIGHT	PIPE SECTION		EMBEDMENT LENGTH
	Size	Wt./Ft.	
to 6 Feet	2.875" O.D.	5.79 lbs.	36"
6 to 13 Feet	4.00" O.D.	9.10 lbs.	36"
13 to 18 Feet	6.625" O.D.	18.79 lbs.	42"

D. Post caps for pipe sections shall be designed to exclude all moisture. Where barbed wire is specified, extension arms shall be integral with post caps. Where top rail is specified, post caps shall have an opening for top rail. All post caps shall have a 2 inch skirt for rigidity.

E. Top rail, where called for, shall be 1.625 inch O.D. steel pipe weighing 2.27 lbs./ft. Top rail shall be furnished in random lengths not less than 18- feet per section and shall be joined with outside sleeve, steel couplings not less than 6 inches long and having a wall thickness of not less than 0.07 inch. Couplings shall be designed to allow for expansion movement of the top rail.

F. Tension wire shall be 7 gauge galvanized carbon steel wire with a minimum breaking strength of 1,950 lb. Tension wire shall be furnished for the bottom edge of all fence fabric, and for the top edge when a top rail is not specified.

G. Trussed bracing shall be furnished for each panel adjacent to a terminal, pull, corner or gate post. Compression member shall be 1.625 inch O.D. pipe, as specified for top rail material. Tension members shall be 3/8 inch diameter galvanized steel rods with turnbuckles.

H. For 5 and 6 foot fences with top tension wire, braced panels shall consist of horizontal pipe brace, located approximately 4 inches below top of fabric, a diagonal pipe brace, attached at the midpoint of the terminal post and at the bottom of the adjacent line post, and a truss rod, attached to the top of the adjacent line post, extending diagonally to the bottom of the terminal post.

I. For 5 and 6 foot fences with top rail, braced panels shall consist of a horizontal pipe brace, midway between top and bottom of fence fabric, with a truss rod extending from the mid point of the line post diagonally to the bottom of the terminal post.

J. For 4 foot fences with top rail shall be braced with a truss rod connected to the bottom of the terminal post and extending to the top of adjacent line posts.

K. For 4 foot fences without top rail shall have a horizontal brace pipe at the top of the fabric and a diagonal truss rod installed as described above.

2.02 PEDESTRIAN AND VEHICULAR GATES

A. Pedestrian and vehicular gates shall be fabricated from 1.90 inch O.D. pipe weighing 2.72 lbs./ft. The fabric on the gates shall be the same as that specified for fencing. The following accessories shall be furnished for each gate:

1. Corner and tee fittings of malleable iron or pressed steel having means for attaching diagonal members. Hinges of malleable iron providing for full 180 degree swing with bottom hinges to be ball and socket type.
2. Diagonal braces consisting of 3/8 inch diameter truss rods with turn-buckles, two for each gate frame. Vehicular gates shall have vertical 1.90 inch O.D. pipe brace at center of each gate leaf.
3. Latches for single gates shall have a single fork latch with padlock eye; double leaf gates shall have two fork latches mounted on center plunger rod with padlock eye.
4. Hold backs shall be provided for each leaf of vehicular gates, employing a semi-automatic hold back catch to be anchored at least 12 inches into a 12 inch diameter by 24 inch deep concrete footing.
5. A malleable iron center rest, designed to receive the plunger rod, to be anchored at least 12 inches into a 12 inch diameter by 24 inch deep concrete footing, shall be provided for all double leaf gates.

B. The top of all gate frames shall align with the fencing top rail. Vehicular gates shall be 4 inches greater in overall height than the adjacent fencing so as to extend to within 2 inches of pavement between 6 inch curbs, if curbs are designated on the plans.

2.03 ROLLING GATES

A. Rolling gates shall be fabricated from 1.90 inch O.D. vertical pipe weighing 2.72 lbs./ft. and 2.375 inch horizontal pipe weighing 3.65 lbs./ft. The fabric on the gates shall be the same as that specified for fencing. The following accessories shall be furnished for each rolling gate:

1. Diagonal braces consisting of 1.625 inch O.D. pipes, one for each gate bay(s) and two for counterbalance bay(s).
2. Single rolling gate application shall have one 4 inch post latch and one 2 inch cantilever latch with padlock; double rolling gate application shall have one 2 inch cantilever latch on each gate with padlock.
3. Single rolling gate application shall have 5 galvanized 4 inch cantilever gate roller assemblies; double rolling gates application shall have 10 galvanized 4 inch cantilever gate roller assemblies.

B. Barbed wire support arms shall be at an angle of 45 degrees from vertical and shall have clips for attaching three strands of barbed wire. Each support arm shall be of sufficient strength to support a 200 lb. weight applied at the outer strand of barbed wire.

C. Barbed wire, where specified, shall be twisted 12-1/2 gauge wire, with 14 gauge 2 point barbs spaced approximately 5 inches apart conforming to ASTM A121 “Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.” Three strands of barbed wire will be required where barbed wire top is specified.

D. Stretcher bars shall be not less than 3/16 inch by 3/4 inch flat steel and not more than 2 inches shorter than the fabric height. One stretcher bar shall be provided for each gate and end post. Two stretcher bars shall be provided for each corner and pull post. Stretcher bars shall be attached to terminal posts with 1 inch by 1/8 inch flat steel bands, with 3/8 inch carriage bolts at intervals not exceeding 15 inches. Steel band diameter shall match the adjoining post.

E. Miscellaneous fittings and fasteners shall be furnished in sufficient quantities to erect all fencing materials in a proper manner.

F. All fencing materials shall be approved by the Engineer to be in accordance with this Item before they are erected. When requested by the Engineer, samples of any fencing component shall be furnished by the Contractor for testing.

2.04 GALVANIZING

A. All material used in chain link fencing shall be hot dip zinc coated as specified by the following:

B. All Posts and Pipe: ASTM A53 “Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless” (1.8 oz/sf)

C. All H-Beam Sections: ASTM A123 “Standard Specification for Zinc (Hot- Dip Galvanized) Coatings on Iron and Steel Products” (2.0 oz/sf)

D. Fence Fabric: ASTM A392 “Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric” Class I (1.2 oz/sf)

E. Tension Wire, Barbed Wire: ASTM A121, Class III (0.80 oz/sf)

F. Post Caps, stretcher Bars and Miscellaneous Fittings, ASTM A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"

G. The weight of zinc coating for all items shall be determined in accordance with ASTM A90 "Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings".

2.05 POLY VINYL CHLORIDE (PVC) FENCE COATINGS:

A. Chain link fence will be factory coated in black polyvinyl chloride coating. ASTM F668 (Specification for Poly (Vinyl Chloride)/(PVC) - Coated Steel Chain Link Fabric) with a coating between 15 and 25 mil.

2.06 SIGNS

A. Signs shall be manufactured by Accuform (Brooksville, FL) or approved equal.

B. All lettering shall be Helvetica Medium, sized and in both upper and lower case, as specified and scheduled.

C. Restrictive/Caution Signs and Hazard Identification System shall be SPF constructed of 0.080-in vinyl laminated to a 0.080-in acrylic backing.

D. Letters or symbols shall be screen printing or ASP process both in subsurface locations.

E. Restrictive/Caution Signs shall have 1-in radius rounded corners.

F. Color of acrylic and letters shall be in accordance with OSHA standards.

G. All other aspects of the Restrictive/Caution Sign shall be in accordance with OSHA standards. Hazard identification system shall conform to National Fire Protection Association (NFPA) NFPA 704 with a large diamond shape made up of four smaller diamonds with numbers on the diamonds corresponding to the labels for the chemical represented. Small diamonds are to be 5-in on a side with 4-in letters. The overall diamond shall be 10-in on a side. The health diamond shall be blue with a white number. The flammability diamond shall be red with a white number. The Reactivity diamond shall be yellow with a blue number. The unusual reactivity diamond shall be white with a red symbol. Health diamond is on the left. Flammability diamond is on the top. Reactivity diamond is on the right. Special reactivity diamond is on the bottom. Reference for the contents of these signs for each chemical is NFPA 49. If OSHA standards do not apply, the color of the acrylic shall be red with white letters 1-in high. Signs shall be wall surface mounted continuous across sign with concealed fasteners. Other means of fastening may be used on fences and other unusual mounting locations such as tanks.

H. Signs shall be suitable for interior or exterior use.

2.07 EXTERIOR SIGNS

A. Exterior signs shall be made of thermosetting polyester resin reinforced with chopped glass fiber strands and fabricated in a 6-in, 8-in, or 12-in profile seamless construction depending upon the standard design that is reinforced to eliminate cupping and warping plus withstand a 50-psf windload. Graphics shall be subsurface, integral with the molded sign face structure, protected with a polyurethane resign coating system containing ultraviolet

inhibitors, and using Helvetica Regular upper and lower case letters as detailed on the Sign Schedule. Medium bronze or blue letters and arrows on a tan background shall be used for the site signs as scheduled with blue noted and all other medium bronze. Lettering shall appear on both faces of the signs indicated in the schedule by sides marked "a" and "b." Size shall be as scheduled for the plant sign and site signs.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. The Contractor shall perform all clearing of brush and debris, which may be necessary for the installation of this fencing.

B. The fencing panels between corner and terminal posts shall generally follow the finished ground elevations. However, the Contractor shall grade off minor irregularities in the path of the fencing as necessary to limit the variation of grade under the bottom edge of fence fabric to a distance of not more than 6 inches and not less than 2 inches to the ground.

C. The maximum spacing for line posts shall be 10 feet. Pull posts shall not be located more than 500 feet apart and at each change in direction exceeding 20 degrees, both horizontally and vertically. Runs of fencing over 500 feet but less than 1,000 feet shall have a pull post in the center of the run.

D. Holes for concrete footings, for all posts, shall be drilled to the dimensions listed in the following tables.

TABLE 4
HOLES FOR LINE AND END POSTS

TYPE POST	FABRIC HEIGHT	MIN. HOLE DIAMETER	MIN. HOLE DEPTH	POST EMBEDMENT
Line	4 Feet	9”	30”	24”
Line	5 Feet - 6 Inches	9”	30”	24”
End	4 Feet	12”	36”	30”
End	5 Feet - 6 Inches	12”	42”	36”

TABLE 5
HOLES FOR GATE POSTS

Gate Post Size	Min. Hole Diameter	Min. Hole Depth	Post Embedment
2.875”OD x 5.79 lbs	12”	42”	36”
4.000”OD x9.10 lbs	18”	42”	36”
6.625”OD x 18.97 lbs	18”	48”	42”

E. Concrete for footings shall be Class B and shall be in accordance with the Item 421 “Structural Concrete”. All concrete footings shall be cast up to finish grade and crowned one

inch to shed water. Excess concrete not used in the footings, and any other construction debris shall be removed from the site.

F. The fence fabric shall be erected by securing one end and applying sufficient tension to the other end to remove all slack before making attachments. The fabric shall be cut and each span shall be attached independently at all corner posts and pull posts.
G. Fastening to end, pull, corner and gate posts shall be with stretcher bars which shall be secured to the posts with stretcher bar bands at intervals not exceeding 15 inches.
H. Fence fabric shall generally follow the finished contour of the site with the bottom edge of the fabric located 2 inches above the grade.

3.02 SIGN INSTALLATION

A. Signage shall be installed at the locations described in the specifications, shown on the Drawings, or as directed, in accordance with the Manufacturers' recommendations and shop drawings.
B. Damaged items shall be removed and replaced at no cost to the Owner.
C. Signage shall be cleaned to the satisfaction of the Engineer using the approved methods, and upon completion of the installation and again, just prior to acceptance of the project.

D. Restrictive Signs

Quantity	Sign Text	Location	Colors	Height (inch)	Width (inch)
2	CITY OF WEST UNIVERSITY PLACE, TEXAS WASTEWATER TREATMENT PLANT FOR EMERGENCIES CONTACT (713) 662-5839 OR 911	Near Exterior Gates	Black Text White Background Black Border	20	30
2	DANGER CHLORINE	Near Exterior Gates	Red Danger Oval with White Text Black Text White Background Black Border	10	14
2	DANGER NO TRESPASSING	Near Exterior Gates	Red Danger Oval with White Text Black Text White Background Black Border	10	14
2	DANGER HIGH VOLTAGE	Near Exterior Gates	Red Danger Oval with White Text White Background Black Border	10	14
2	DANGER OPEN TANKS	Near Exterior Gates	Red Danger Oval with White Text White Background Black Border	10	14
5	EMERGENCY EYE WASH STATION	Near Exterior Gates And at each eye wash station	White Text Green Background White Border	10	14

Quantity	Sign Text	Location	Colors	Height (inch)	Width (inch)
2	See TCEQ Text below	Near Exterior Gates	See TCEQ website below.	25	20

E. TCEQ Text:

1. Use the following text:
   WARNING!
   Public Water System
   TAMPERING WITH THIS FACILITY IS A FEDERAL OFFENSE!!!
   INDIVIDUALS WHO ILLEGALLY ENTER, TAMPER, OR THREATEN TO DO EITHER WILL BE PROSECUTED TO THE FULLEST EXTENT OF THE LAW!
   FEDERAL STATUTE (42 USC 300i-1)
   MAXIMUM PENALTY UP TO 20 YEARS PRISON TERM
   MAXIMUM FINE UP TO $1 MILLION
   TEXAS STATUTE {5 TPC 22.07(a)(4)} and {7 TPC 28.03(a)(1), (2), & (3)}
   MAXIMUM PENALTY UP TO 10 YEARS PRISON TERM
   MAXIMUM FINE UP TO $10,000
   To Report Suspicious Behavior:
   Call 911 immediately and notify the Texas Commission on Environmental Quality at 888-777-3186

F. TCEQ website: See https://www.tceq.texas.gov/assistance/water/pdws/sign-template-for-public-water-systems for colors.

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 32 92 13

HYDROMULCH SEEDING AND SODDING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Establishment of a uniform, full-coverage of grass by hydromulch seeding is required in all disturbed areas and other areas indicated on the Plans.

B. Hydromulch seeding includes mixing fertilizer, grass seed and mulch material with water and spraying the mixture onto tilled topsoil. Seeding includes spreading fertilizer, and grass seed onto tilled topsoil.

C. Furnish all materials, labor and equipment including watering system to establish full coverage grass where specified and to maintain the established areas for 60 days.

1.02 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perrenial Sorrel, and Brome Grass.

1.03 SUBMITTALS

A. Submit data on fertilizer, seed, and mulch as necessary to show compliance with these specifications. Include source of supply for materials as well as:
   1. Name, trademark, warranty, analysis, form, and coverage for fertilizer.
   2. Name, type, germination, purity, germination test results with date of test for seed.
   3. Name, type, components and coverage for mulch.

B. Submit maintenance instructions, cutting method, minimum and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.04 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.05 QUALITY ASSURANCE

A. Provide seed in containers showing name and type of seed, year of production, net weight, date of packaging, date of germination test, and location of packaging.

B. Provide fertilizer in containers bearing the name, trademark warranty of producer, the weight and analysis, and form of constituents.

C. In the designated areas for grass establishment, it shall be the sole responsibility of the CONTRACTOR to establish uniform stand of grass which is defined as not less than 150 growing plants per square foot of seeded area, regardless of adverse climatic or other conditions. The resident engineer may stop work if unfavorable conditions are likely until favorable conditions are present.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged, wet, or moldy packaging is not acceptable. Store in dry location.

B. Deliver fertilizer in waterproof bags. Store in dry location not in contact with runoff.

1.07 MAINTENANCE SERVICE

A. For areas where establishment is required per the Plans and Paragraph 1.06 A., maintain the hydromulched areas for 60 days beginning immediately after placement and watering as required until grass is well established and exhibits a vigorous growing condition. Coordinate water requirements with availability of water from OWNER and areas to be seeded at one time.

PART 2 PRODUCTS

2.01 SEED MIXTURE

A. Seed Type: Hulled extra fancy grade, common Bermuda (Cynodon dactylion).

B Seed Quality:

1. All seed shall meet the requirements of the Texas Seed Law including labeling requirements for showing pure live seed (PLS = purity x germination), name and type of seed.
2. All seed shall be treated with a fungicide.
3. Seed which has become wet, moldy or otherwise damaged in transit or storage will not be acceptable.
4. Seed shall be new crop seed (harvested within 1 year prior to planting), free

of other weed seed to the limits allowable under the Texas Seed Law.

5. The seed shall have a germination and purity that will produce a pure live seed content of not less than 85 percent.

2.02 FERTILIZER

A. Fertilizer shall be a commercial product uniform in composition, free flowing, and suitable for application with standard equipment. The fertilizer shall comply with the applicable State fertilizer laws and shall be delivered in bags or other convenient containers, each fully labeled and bearing the name, trademark, and warranty of the producer. Fertilizer applied during the initial planting shall have analysis ratio of 20-20-20 also containing traces of sulfur, iron and zinc. Fertilizer used in the second application shall have an analysis ratio of 12-4-8. The figures in the analysis represent the percent of nitrogen, phosphorus, and potash nutrients, respectively as determined by methods of the Association of Official Agricultural Chemists. Fifty percent or greater of the nitrogen required shall be in the form of nitrate nitrogen. The remaining nitrogen may be in the form of urea nitrogen.

B. In the event it is necessary to substitute a fertilizer of a different analysis or form, the total amount of nutrients applied per 1000 square feet shall equal or exceed that specified for each nutrient.

C. Fertilizer which has become caked or exposed to excess humidity or mixture will not be acceptable.

2.03 HYDROMULCH

A. Hydromulch material for areas requiring grass establishment shall be Second Nature Hydroseeding Mulch as manufactured by Central Fiber Corporation, or approved equivalent.

B. Mulch shall be manufactured of natural fiber stock free of plastics and foreign materials. Mulch shall have a green non-toxic dye, disperse rapidly in water to form a homogeneous slurry and shall remain in suspension. It shall have a water holding capacity of not less than 1300 gms water per 100g fiber.

2.04 MULCH

A. Furnish straw mulch free of weeds and spread at the recommended rate to adequately cover all areas which are broadcast seeded and indicated to be mulched.

2.05 SOIL MATERIALS

A. Topsoil: Refer to material requirements in Section 31 30 00.

2.06 ACCESSORIES

A. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

B. Erosion Fabric: Jute matting, open weave, where shown on Plans or where slope is steeper than 3:1.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that prepared soil base is ready to receive the work of this Section that topsoil has been placed and final grading is acceptable to OWNER.

B. Beginning of installation means acceptance of existing site conditions.

3.02 FINAL GRADING

A. All areas to be seeded shall have sufficient topsoil placed prior to seeding.

B. Smooth areas that have become gullied; and loosen or retill areas that have become compacted since completion of grading to a depth of 6 inches.

3.03 FERTILIZING

A. Apply initial fertilizer in accordance with manufacturer's instructions at a minimum rate of 15 lb per 1000 sf with hydromulch mixture.

B. A second application of fertilizer shall be applied to the establishment areas between 45 and 60 days from seeding, at a rate of 8 pounds per 1000 sf.

3.04 SEEDING

A. For hydromulch (grass establishment) areas, hydromulch mixture containing the seed, fertilizer, mulch and water shall be prepared in accordance with the following quantities. Mixture shall be applied to planting area using conventional "Hydromulch" equipment. For seeded areas, seed and fertilizer shall be spread with mechanical spreaders to obtain the specified rates.

Component	Rate per 1000 sf
Grass seed	2.5 pounds
Fertilizer	15 pounds
Water	As Needed
Paper Fiber Mulch	Recommended by Manufacturer

B. Planting Season:
   1. March 1 to August 31.
   2. Seeding shall not be done during periods other than listed above.

C. For areas to be established, apply water with a fine spray immediately (within 24 hours) after each area has been seeded and mulched. Saturate to 4 inches of soil. Water daily as often as necessary for 4 weeks to establish grass.

3.05 SEED PROTECTION

A. Cover seeded slopes where grade is steeper than 4 inches per foot with erosion fabric. Roll fabric onto slopes without stretching or pulling. Cover hydromulched areas as recommended to obtain establishment of grass.

B. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12-inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.

C. Secure outside edges and overlaps at 36-inch intervals with stakes.

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

F. No heavy equipment shall be moved over planted area unless area is to be retilled and reseeded.

3.06 MAINTENANCE FOR HYDROMULCHED AREAS

A. The CONTRACTOR shall mow grass as required.

B. CONTRACTOR shall water as required to establish grass and to prevent grass and soil from drying out for the initial 60-day period.

C. CONTRACTOR shall control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

D. Prior to the second fertilizer application, CONTRACTOR shall reseed areas which show bare spots of 2 square feet or larger. Minimum of 95 percent coverage shall be required for OWNER acceptance.

E. CONTRACTOR shall maintain grass and reseed as required to establish 95 percent coverage (within a minimum of 60 days) or 150 plants per square foot.

F. Protect seeded areas with warning signs during maintenance period, if necessary.

END OF SECTION

SECTION 33 01 12

HYDROSTATIC TESTING & DISINFECTION

PART 1 - GENERAL

1.1 SUMMARY

A. General

1. Before any newly constructed potable water mains will be permitted to be placed into service in the Water Distribution System, it shall be cleaned (purged) and tested, or cleaned, disinfected, and tested until the bacteria count within the water main meets the standards established by the Public Works Department and the requirements of Chapter 290 of the Texas Administrative Code (TAC) established by the Texas Commission on Environmental Quality (TCEQ).

B. Related Specification Sections include but are not limited to:

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement
   a. This Item is considered subsidiary to the water main being Cleaned and Tested.
2. Payment
   a. The Work performed and the materials furnished in accordance with this Item are subsidiary to cleaning, disinfection, hydrostatic testing, and bacteriological testing and shall be subsidiary to the unit price bid per linear foot of water pipe complete in place, and no other compensation will be allowed.

1.3 REFERENCES

A. Reference Standards

1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
2. American Water Works Association/American (AWWA):
   a. C301, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
   b. C303, Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
   c. C651, Disinfecting Water Mains.
   d. C655, Field De-Chlorination.

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

C. For 12-inch and larger water mains, provide the following:

1. Cleaning Plan – Prior to the start of construction, submit a water main cleaning plan detailing the methods and schedule, including:
   a. A detailed description of cleaning procedures
   b. Pigging entry and exit ports
   c. Flushing procedures
   d. Plans and hydraulic calculations to demonstrate adequate flushing velocities
   e. Control of water
   f. Disposal
2. Disinfection Plan – prior to the start of construction submit a disinfection plan including:
   a. The method mixing and introducing chlorine
   b. Flushing
   c. De-chlorination
   d. Sampling

PART 2 - PRODUCTS

2.1 PRODUCT TYPES

A. Pigs

1. Open cell polyurethane foam body
2. Densities between 2 pounds per cubic foot up to 8 pounds per cubic foot
3. May be wrapped with polyurethane spiral bands
4. Abrasives are not permitted, unless expressly approved by the City in writing for the particular application.
5. Must pass through a reduction up to 65 percent of the cross sectional area of the nominal pipe diameter
6. Pigs shall be able to traverse standard piping arrangements such as 90 degree bends, tees, crosses, wyes, and gate valves.

PART 3 - EXECUTION

3.1 CLEANING

A. General

1. All water mains shall be cleaned prior to bacteriological testing.
   a. Flushing is only permitted when specially designated in the Drawings, or if pigging is not practical and approved by the City.
   b. If bacteria test fails twice, pigging will be required on 16-inch and large water mains.

B. Pigging Method

1. If the method of pigging is to be used, prepare the main for the installation and removal of a pig, including:
   a. Furnish all equipment, material and labor to satisfactorily expose cleaning wye, remove cleaning wye covers, etc.
   b. Where expulsion of the pig is required through a dead-ended conduit:

1) Prevent backflow of purged water into the main after passage of the pig.
2) Install a mechanical joint to provide a riser out of the trench on 12-inch and smaller mains to prevent backwater re-entry into the main.
3) Additional excavation of the trench may be performed on mains over 12 inches, to prevent backwater re-entry into the main.
4) Flush any backflow water that inadvertently enters the main.

c. Flush short dead-end pipe sections not swabbed by a pig.
d. Once pigging is complete:
1) Pigging wyes shall remain in place unless otherwise specified in the Contract Documents.
2) Install cleaning wye, blind flanges or mechanical joint plugs.
3) Plug and place blocking at other openings.
4) Backfill
5) Complete all appurtenant Work necessary to secure the system and proceed with disinfection.

C. Flushing Method

1. Prepare the main by installing blow-offs at appropriate locations, of sufficient sizes and numbers, and with adequate flushing to achieve a minimum velocity in the main of 2.5 feet per second.
a. A fire hydrant shall be used as blow off for all water mains.
b. Flushing shall be subject to the following limitations:
1) Limit the volume of water for flushing to 3 times the volume of the water main.
2) Do not unlawfully discharge chlorinated water.
3) Do not damage private property.
4) Do not create a traffic hazard.
c. Once Flushing is complete:
1) Corporations stops used for flushing shall be plugged.

D. Daily main cleaning

1. Wipe joints and then inspect for proper installation.
2. Sweep each joint and keep clean during construction.
3. Install a temporary plug on all exposed mains at the end of each working day or an extended period of Work stoppage.

E. Hydrostatic Testing

1. All water mains and force mains that are under pressure, shall be hydrostatically tested to meet the following criteria:
a. Furnish and install appurtenances for proper testing of the main.
1) All pipe has been installed and backfilled.
2) All service connections, fire hydrants and other appurtenances have been installed, connected and adjusted.
3) All surface pavement, lot grading and other related construction activities are complete within the area of line to be accepted.
b. A pressure and leakage test will be conducted by the contractor and monitored by the city inspector.
1) The contractor shall furnish the pump, meter, and gauges for the tests.

2) If permanent air vents are not located at all dead ends and high points, the contractor shall install corporation stops at such points. Location of test pump may require additional corporation stops. At the conclusion of the pressure test, the corporation stops shall be properly plugged and secured to prevent leakage.
3) All potable water provided for water test shall be through a City provided contractors' meter assembly and backflow preventer. No direct connection will be allowed for filing of lines.
4) All valve connections between a system that is presently serviced and an unaccepted system shall be operated only by City personnel.
5) Pressurization and flush of the line will be coordinated by the City, with ample notification.
6) Charges for water usage will be consistent with current City policy.

c. Expel air from the pipe before applying the required test pressure.
d. Test Pressure
1) The specified test pressures will be based on the elevation of the lowest point on the line under test.
2) The leakage test shall be at 150 psi for 4 hours or 125 psi for 8 hours.
3) Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe, to maintain the specified leakage test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
e. Test Conditions
1) Must be at least 4-hour duration
2) Add water as necessary to sustain the required test pressure.
3) Test fire hydrants to the fire hydrant valve.
a) Leave the isolation valve on the fire hydrant lead line open during the hydrostatic testing.
4) Test service lines to curb stop
a) Leave the corporation stop on the service line open during the hydrostatic testing.
5) Close isolation valves for air release valves.
f. Measure all water used in the pressure test through an approved meter, or measure the difference in volume within a 55-gallon container.
1) Do not test against existing water distribution valves unless expressly provided for in the Drawings or approved by the City.
2) If the City denies approval to test against existing water distribution system valve, then make arrangements to plug and test the pipe at no additional cost.

2. Allowable Leakage
a. No pipe installation should be accepted if the leakage is greater than that determined by the current AWWA Standards "Allowable Leakage" for the applicable pipe material. All visible leaks are to be repaired regardless of the amount of leakage.
b. For any pipeline that fails to pass hydrostatic test:
1) Identify the cause
2) Repair the leak
3) Restore the trench and surface
4) Retest
c. All costs associated with repairing the pipeline to pass the hydrostatic test is the sole responsibility of the Contractor and included in the price per linear foot of pipe.

d. If the City determines that an existing system valve is responsible for the hydrostatic test to fail, the Contractor shall make provisions to test the pipeline without the use of the system valve.
e. There shall be no additional payment to the Contractor if the existing valve is unable to sustain the hydrostatic test and shall be included in the price per linear foot of pipe.

F. Disinfection
   a. General Sanitary precautions, flushing, and disinfections procedures and bacteriological sampling, as prescribed in AWWA Standard C 601 for disinfecting water-mains, shall be followed in laying waterlines.
   b. Pipe shall not be laid in water or placed where it can be flooded with water or sewage during storage or installation. The effectiveness of disinfections depends in large measure on maintaining clean pipes and avoiding major contamination during construction.
   c. All newly installed mains shall be disinfected in accordance with ANSI/AWWA C 601 and flushed and sampled before being placed in service.
   d. After satisfactory completion of the hydrostatic testing, OWNER personnel will flush and collect samples for bacteriological analysis to check the efficiency of the disinfections procedure, which shall be repeated if contamination persists.
      1) A minimum of one sample for each 1,000 feet of completed main will be required.
      2) Charges for water usage will be consistent with current City policy.
   e. Following the chlorination period, all treated water flushed from the lines shall be disposed of by discharging to the nearest sanitary sewer or other approved means.
      1) No discharge to any storm sewer or natural water course will be allowed.
      2) Calcium hypochlorite granules shall be used as the source of chlorine.

   2. Contractor Requirements
      a. Furnish all equipment, material and labor to satisfactorily prepare the main for the disinfection method approved by the City with adequate provisions for sampling.
      b. Make all necessary taps into the main to accomplish chlorination of a new line, unless otherwise specified in the Contract Documents.
      c. After satisfactory completion of the disinfection operation, as determined by the City, remove surplus pipe at the chlorination and sampling points, plug the remaining pipe, backfill and complete all appurtenant Work necessary to secure the main.

G. Dechlorination
   1. General. All chlorinated water shall be de-chlorinated before discharge to the environment. Chemical amounts, as listed in ANSI/AWWA C651: “Disinfecting Water Mains”, shall be used to neutralize the residual chlorine concentrations using de-chlorination procedures listed in ANSI/AWWA C655: “Field De-Chlorination”. De-Chlorination shall continue until chlorine residual is below 4.0 mg/L.
   2. Testing. Contractor shall continuously test for the chlorine residual level immediately downstream of the de-chlorination process, during the entire discharge of the chlorinated water. Contractor shall periodically conduct chlorine residual testing and check for possible fish kills at locations where discharged water enters the existing watershed.
   3. Fish Kill. If a fish kill occurs associated with the discharge of water from the distribution system or any other construction activities:
      a. The Contract shall immediately alter activities to prevent further fish kills.
      b. The Contractor shall immediately notify Public Works.
      c. The Contractor shall coordinate with City to properly notify TCEQ.

d. Any fines assessed by the TCEQ (or local, state of federal agencies) for fish kills shall be the responsibility of the Contractor.

H. Bacteriological Testing (Water Sampling)

1. General
   a. Notify the City when the main is suitable for sampling.
   b. The City shall then take water samples from a suitable tap for analysis by the City's laboratory, unless otherwise specified in the Contract Documents.
2. Water Sampling
   a. Contractor will make sure all valves including isolation valves are 100% open.
      1) If all valves are not open, we will inform the City inspector.
   b. Contractor will introduce a dose of chlorine fed at a constant rate such that the water will have no less than 25 mg/L free chlorine. Chlorine application shall not cease until the entire main is filled with chlorinated water.
   c. The chlorinated water shall be retained in the main for at least 24 hr.
   d. At the end of the 24 hr period, Water Production will check that the treated water in all portions of the main shall have a residual of no less than 10 mg/L of free chlorine.
      1) If WQ checks the main and it is less than 10 mg/L after 24 hr period, we will stop the Work and let the City Inspector know that the new main failed chlorination and it will be up to the contractor to re-chlorinate.
   e. Once Water Production has a satisfactory residual of at least 10 mg/L in the new water main we will schedule a bacteriological test with the City Inspector.
   f. We will flush every hydrant at maximum flow for a minimum of 10 minutes each. Then we will sample 1 time every 1,000 ft of pipe.
      1) If there is a defected hydrant or an issue arises that warrants us to stop our test, we will let the City Inspector know what needs to be done to correct the problem.
      2) The City Inspector will let Water Production know when the problem has been corrected.
      3) Once Water Production has the green light from the City Inspector, we will continue sampling. Depending on the severity of the problem, the contractor may be responsible to re-chlorinate the line.
   g. After sampling we will have our laboratory pick up the samples at the next scheduled time.
      1) If a sample has failed, we will flush again and resample 1 time.
      2) The second time the sample has failed, we will start over from the beginning and the contractor will be responsible to chlorinate the line again and pig in accordance with 3.10 B.
   h. When we get notified that all samples have passed, we will inform the City Inspector and we will activate the new water main.

I. Site Cleaning

1. Keep the construction site cleaned as indicated in Section 01 74 23.

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 33 01 16

BYPASS PUMPING OF EXISTING SEWER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bypass pumping of the existing sewer system for 15-inch and larger sewer mains, unless otherwise specified in the Contract Documents.

B. Related Specification Sections include but are not limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. Measurement
      a. Measurement for this item will be by lump sum.
   2. Payment
      a. The Work performed and materials furnished in accordance with this item will be paid for at the lump sum price bid for “Bypass Pumping”.
   3. The price bid shall include:
      a. Mobilization
      b. Development of bypass plans
      c. Transportation and storage
      d. Setup
      e. Confined space entry
      f. Plugging
      g. Pumping
      h. Clean up
      i. Manhole restoration
      j. Surface restoration

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
   2. Occupational Safety and Health Organization (OSHA).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination
   1. Schedule meeting with City to review sewer shutdown prior to replacing or rehabilitating any facilities.
   2. City reserves the right to delay schedule due to weather conditions or other unexpected emergency within the sewer system.
   3. Review bypass pumping arrangement or layout in the field with City prior to beginning operations. Facilitate preliminary bypass pumping run with City staff present to affirm the operation is satisfactory to the City.
   4. After replacement or rehabilitation of facilities, coordinate the reestablishment of sewer flow with City.
   5. Provide onsite continuous monitoring during all bypass pumping operations using one of the following methods:
      a. Personnel on site, or
      b. Portable SCADA equipment.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. For lift stations and 15-inch and larger sewer mains, submit a detailed plan and description outlining all provisions and precautions taken with regard to the handling of sewer flows.
   1. Submit the plan to the City for approval a minimum of 14 days prior to commencing Work. Include the following details:
      a. Schedule for installation and maintenance of the bypass pumping system
      b. Staging areas for pumps
      c. Pump sizes, capacity, number of each size, and power requirements
      d. Calculations for static lift, friction losses, and velocity
      e. Pump curves showing operating range and system head curves
      f. Sewer plugging methods
      g. Size, length, material, joint type, and method for installation of suction and discharge piping
      h. Method of noise control for each pump and/or generator, if required
      i. Standby power generator size and location
      j. Suction and discharge piping plan
      k. Emergency action plan identifying the measures taken in the event of a pump failure or sewer spill
      l. Staffing plan for responding to alarm conditions identifying multiple contacts by name and phone numbers (office, mobile)
      m. A contingency plan to implement in the event the replacement or rehabilitation has unexpected delays or problems

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING [NOT USED]

1.11 FIELD CONDITIONS [NOT USED]

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-FURNISHED PRODUCTS [NOT USED]

2.2 EQUIPMENT

A. Pumping
   1. Provide equipment that will convey the following:
      a. City-provided flow data.
         1) Full flow capacity of the sewer main, if data is not available
            a) Calculate using Manning's equation assuming the following:
               (1) Roughness coefficient, n = 0.013
   2. Provide fully automatic self-priming pumps.
      a. Foot-valves or vacuum pumps are not permitted for priming the system.
   3. Pumps must be constructed to allow dry running for periods of time to account for the cyclical nature of sewer flow.
   4. Provide 1 stand-by pump for each size to be maintained on site. Place backup pumps on line, isolated from the primary system by valve.
   5. If multiple pumps are required to meet the flow requirements, provide the necessary fittings and connections to incorporate multiple discharges.
   6. Noise levels of the pumping system must follow the more stringent of the requirements below:
      a. City noise ordinance
      b. No more the 65dB when measured at a distance of 300-ft from the source.
         1) The noise level will be the average of sound level meter readings taken consecutively at any given time from 4 or more diametrically opposite positions measured at a distance of 300-ft from the source.
      c. May be subject to special noise mitigation as required by the City.

B. Piping
   1. Install pipes with joints which prevent the incident of flow spillage.

C. Plugs or Stop Logs
   1. Plugs
      a. Select a plug made for the size and potential pressure head that will be experienced.
      b. Provide an additional anchor, support, or bracing to secure plug when back pressure is present.
      c. Use accurately calibrated air pressure gauges for monitoring the inflation pressure.

d. Place inflation gauge at location outside of confined space area. Keep the inflation gauge and valve a safe distance from the plugs.
e. Never over inflate the plug beyond pressure rating.

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION

A. Locate the bypass pipelines in the area to minimize disturbance to existing utilities. Obtain approval from the City for use of locations.

B. Make preparations to comply with OSHA requirements when working in the presence of sewer gases, oxygen-deficient atmospheres, and confined spaces.

C. Do not begin bypass preparation and operation until City approval of the submittals requested in accordance with the requirements of this Section.

3.4 INSTALLATION

A. Install and operate pumping and piping equipment in accordance to the submittals provided in accordance with the requirements of this Section.

B. Sewer flow stoppage
   1. Plugging
      a. Use confined space procedures and equipment during installation when necessary.
      b. Thoroughly clean the pipe before insertion of the plug.
      c. Insert the plug seal surface completely so it is fully supported by the pipe.
      d. Position the plug where there are not sharp edges or protrusions that may damage the plug.
      e. Use pressure gauges for measuring inflation pressures.
      f. Minimize upstream pressure head before deflating and removing.

C. Sewer flow control and monitoring
   1. Take precautions to ensure sewer flow operations do not cause flooding or damage to public or private property.
      a. The Contractor is responsible for any damage resulting from bypass pumping operations.
   2. Begin continual monitoring of the sewer system as soon as the sewer is plugged or blocked. Be prepared to immediately start bypass pumping if needed due to surcharge conditions.

3. Sewer discharge may be into another sewer manhole, appropriate vehicle, or container only. Do not discharge sewer into an open environment such as an open channel or earthen holding facility.
4. Do not construct bypass facilities where vehicular traffic may travel over the piping.
   a. Provide details in the suction and discharge piping plan that accommodate both the bypass facilities and traffic without disrupting either service.

3.5 REPAIR [NOT USED]

3.6 RE-INSTALLATION [NOT USED]

3.7 FIELD QUALITY CONTROL

A. Field Tests and Inspections
   1. Perform leakage and pressure tests of the bypass pumping pipe and equipment before actual operation begins. Have City on Site during tests.

3.8 SYSTEM STARTUP [NOT USED]

3.9 ADJUSTING [NOT USED]

3.10 CLEANING [NOT USED]

3.11 CLOSEOUT ACTIVITIES

A. Once plugging or blocking is no longer necessary, remove in such a way that permits the sewer flow to slowly return to normal – preventing surge, surcharging, and major downstream disturbance.

3.12 PROTECTION [NOT USED]

3.13 MAINTENANCE [NOT USED]

A. Contractor shall have a responsible person available for maintenance and repairs within a 2-hour notification for the entire duration of the bypass pumping activity.

3.14 ATTACHMENTS [NOT USED]

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 33 01 30
SEWER AND MANHOLE TESTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Testing for sanitary sewer pipe and manholes prior to placing in service
      a. Low Pressure Air Test and Deflection (Mandrel) Test
         1) Excludes pipe with flow
         2) Hydrostatic Testing is not allowed.
      b. Vacuum Testing for sanitary sewer manholes
   2. Before any newly constructed sanitary sewer pipe and manholes are placed into service it shall be cleaned and tested.
   3. Pipe testing will include low pressure air test and deflection (mandrel) test.
   4. Hydrostatic testing is not allowed.
   5. Manhole testing will include vacuum test.

B. Related Specification Sections include, but are not necessarily limited to:
   1. Division 00 – Bidding Requirements and Contract Information
   2. Division 01 – General Requirements

1.02 SUBMITTALS

C. Submittals shall be in accordance with Section 01 33 23.

D. All submittals shall be approved by the Engineer or the City prior to delivery.

1.03 CLOSEOUT SUBMITTALS

E. Test and Evaluation Reports
   1. All test reports generated during testing (pass and fail).

1.04 QUALITY ASSURANCE

F. Certifications
   1. Mandrel Equipment
      a. If requested by City, provide Quality Assurance certification that the equipment used has been designed and manufactured in accordance to the required specifications.

PART 2 PRODUCTS [NOT USED]

PART 3 EXECUTION

3.01 PREPARATION

A. Low Pressure Air Test (Pipe)
   1. Clean the sewer main before testing, as outlined in this Specification.
   2. Plug ends of all branches, laterals, tees, wyes, and stubs to be included in test.

B. Deflection (mandrel) test (Pipe)
   1. Perform as last work item before final inspection.
   2. Clean the sewer main and inspect for offset and obstruction prior to testing.
   3. Materials
      a. Mandrel used for deflection test
         1) Use of an uncertified mandrel or a mandrel altered or modified after certification will invalidate the deflection test.
         2) Mandrel requirements
            a) Odd number of legs with 9 legs minimum
            b) Effective length not less than its nominal diameter
            c) Fabricated of rigid and nonadjustable steel
            d) Fitted with pulling rings and each end
            e) Stamped or engraved on some segment other than a runner indicating the following:
               (1) Pipe material specification
               (2) Nominal size
               (3) Mandrel outside diameter (OD)
            f) Mandrel diameter must be 95 percent of inside diameter (ID) of pipe.

C. Vacuum test (Manhole)
   1. Plug lifting holes and exterior joints.
   2. Plug pipes and stubouts entering the manhole.
   3. Secure stubouts, manhole boots, and pipe plugs to prevent movement while vacuum is drawn.
   4. Plug pipes with drop connections beyond drop.
   5. Place test head inside the frame at the top of the manhole.

3.02 INSTALLATION

D. Low pressure air test (Pipe)
   1. Install plug with inlet tap.
   2. Connect air hose to inlet tap and a portable air control source.
   3. After the stabilization period (3.5 psig minimum pressure) start the stop watch.

4. Determine time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding time per diameter per length of pipe is computed from the following equation:

$$T = \frac{(0.0850*D*K)}{Q}$$

Where:

T = shortest time, seconds, allowed for air pressure to drop to 1.0 psig
K = 0.000419*D*L, but not less than 1.0
D = nominal pipe diameter, inches
L = length of pipe being tested (by pipe size), feet
Q = 0.0015, cubic feet per minute per square foot of internal surface

5. UNI-B-6, Table 1 provides required time for given lengths of pipe for sizes 4-inch through 60-inch based on the equation above.
6. Stop test if no pressure loss has occurred during the first 25 percent of the calculated testing time.

E. Deflection (mandrel) test (Pipe)

1. For pipe 36 inches and smaller, the mandrel is pulled through the pipe by hand to ensure that maximum allowable deflection is not exceeded.
2. Maximum percent deflection by pipe size is as follows:

Nominal Pipe Size Inches	Percent Deflection Allowed
12 and smaller	5.0
15 through 30	4.0
Greater than 30	3.0

F. Vacuum test (Manhole)

1. Draw a vacuum of 10 inches of mercury and turn off the pump.
2. With the valve closed, read the level vacuum level after the required test time.
3. Minimum time required for vacuum drop of 1 inch of mercury is as follows:

Depth of Manhole, feet	4-foot Dia Seconds	5-foot Dia Seconds	6-foot Dia Seconds
8	20	26	33
10	25	33	41

12	30	39	49
14	35	45	57
16	40	52	67
18	40	59	73
**	T=5	T=6.5	T=8

** For manholes over 18 feet deep, add "T" seconds as shown for each respective diameter for each 2 feet of additional depth of manhole to the time shown for 18 foot depth. (Example: A 30 foot deep, 4-foot diameter. Total test time would be 70 seconds. 40+6(5)=70 seconds)

3.03 MANHOLE VACUUM LEVELS OBSERVED TO DROP GREATER THAN 1 INCH OF MERCURY WILL HAVE FAILED THE TEST.

3.04 FIELD QUALITY CONTROL

G. Non-Conforming Work
   1. Low pressure air test
      a. Should the air test fail, find and repair leak(s) and retest.
   2. Deflection (mandrel) test (Pipe)
      a. Should the mandrel fail to pass, the pipe is considered over-deflected.
      b. Uncover over-deflected pipe. Reinstall if not damaged.
      c. If damaged, remove and replace.
   3. Vacuum test (Manhole)
      a. Should the vacuum test fail, repair suspect area and retest.
         1) External repairs required for leaks at pipe connection to manhole.
         2) Leaks within the manhole structure may be repaired internally or externally.

END OF SECTION

SECTION 33 01 31
Closed Circuit Television (CCTV) Inspection

PART 1 GENERAL

1.1 SUMMARY:

A. Section Includes:
   1. Requirements and procedures for Closed Circuit Television (CCTV) Inspection of sanitary sewer or storm sewer mains.

B. Related Specification Sections include, but are not necessarily limited to:
   1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract
   2. Division 01 – General Requirements
   3. Section 33 03 10 – Bypass Pumping of Existing Sewer Systems

1.2 REFERENCES:

A. Reference Standards
   1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.

1.3 ADMINISTRATIVE REQUIREMENTS:

A. Coordination
   1. Meet with City Water Department staff to confirm that the equipment, software, standard templates, defect codes and defect rankings are being used, if required.

1.4 SUBMITTALS:

A. Submittals shall be in accordance with Section 01 33 23.

B. All submittals shall be approved by the Engineer or the City prior to delivery.

1.5 INFORMATIONAL SUBMITTALS:

A. Pre-CCTV submittals for sanitary sewer lines 24 inches and larger, if required
   1. Project schedule
   2. Listing of cleaning equipment and procedures
   3. Listing of flow diversion procedures

4. Listing of CCTV equipment
5. Listing of backup and standby equipment
6. Listing of safety precautions and traffic control measures

1.6 CLOSEOUT SUBMITTALS:

A. Post-CCTV submittals
   1. 2 copies of CCTV video results on DVD
   2. 2 hard copies of Inspection Report

PART 2 PRODUCTS [NOT USED]

PART 3 EXECUTION

1.7 PREPARATION:

A. CCTV Equipment
   1. Use equipment specifically designed and constructed for such inspection.
   2. Use equipment designed to operate in 100 percent humidity conditions.
   3. Use equipment with a pan (±270 degrees), tilt, and rotates (360 degrees).
   4. Use camera with an accurate footage counter that displays on the monitor the distance of the camera (to the nearest 1/10 foot) from the centerline of the starting manhole.
   5. Use camera with height adjustment so camera lens is always centered at 1/2 the inside diameter, or higher, in the televised pipe.
   6. Provide sufficient lighting to illuminate the entire periphery of the pipe.
   7. Provide color video.

B. Temporary Bypass Pumping – Conform to Section 33 03 10.

1.8 INSPECTION (CCTV):

A. General
   1. Begin inspection immediately after cleaning of the main.
   2. Move camera through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the main's condition.
   3. Do not move camera at a speed greater than 30 feet per minute.
   4. Use manual winches, power winches, TV cable, and power rewinds that do not obstruct the camera view, allowing for proper evaluation.
   5. During investigation stop camera at each defect along the main.

a. Record the nature, location and orientation of the defect or infiltration location as specified in the CCTV Manual.

6. Pan and tilt the camera to provide additional detail at:
   a. Manholes
   b. Service connections
   c. Joints
   d. Visible pipe defects such as cracks, broken or deformed pipe, holes, offset joints, obstructions or debris
   e. Infiltration/Inflow locations
   f. Pipe material transitions
   g. Other locations that do not appear to be typical for normal pipe conditions
7. Provide accurate distance measurement.
   a. The meter device is to be accurate to the nearest 1/10 foot.
8. CCTV inspections are to be continuous.
   a. Do not provide a single segment of main on more than 1 DVD.

B. Pre-Installation Inspection for Sewer Mains to be rehabilitated
   1. Perform Pre-CCTV inspection immediately after cleaning of the main and before rehabilitation work.
   2. If, during inspection, the CCTV will not pass through the entire section of main due to blockage or pipe defect, set up so the inspection can be performed from the opposite manhole.

C. Post-Installation Inspection
   1. Complete manhole installation before inspection begins.
   2. Prior to inserting the camera, flush and clean the main in accordance with City Standards.

D. Documentation of CCTV Inspection
   1. Follow the CCTV Manual for the inspection video, data logging and reporting.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 33 05 06

PIPE BEDDING & BACKFILL MATERIAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation, Embedment and Backfill for:
   a. Pressure Applications
      1) Water Distribution or Transmission Main
      2) Wastewater Force Main
      3) Reclaimed Water Main
   b. Gravity Applications
      1) Wastewater Gravity Mains
      2) Storm Sewer Pipe and Culverts
      3) Storm Sewer Precast Box and Culverts
2. Including:
   a. Excavation of all material encountered, including rock and unsuitable materials
   b. Disposal of excess unsuitable material
   c. Site specific trench safety
   d. Pumping and dewatering
   e. Embedment
   f. Concrete encasement for utility lines
   g. Backfill
   h. Compaction

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract
2. Division 1 – General Requirements
3. Section 03 30 53 – Concrete
4. Section 33 05 91 – Utility Markers, Locators, and Tracer Wire

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Trench Excavation, Embedment and Backfill associated with the installation of an underground utility or excavation
   a. Measurement
      1) This Item is considered subsidiary to the installation of the utility pipe line as designated in the Drawings.
   b. Payment
      1) The Work performed and the materials furnished in accordance with this Item are considered subsidiary to the installation of the utility pipe for the type of embedment and backfill as indicated on the plans. No other compensation will be allowed.
2. Imported Embedment or Backfill
   a. Measurement
      1) Measured by the cubic yard as delivered to the site and recorded by truck ticket provided to the Engineer.
   b. Payment

1) Imported fill shall only be paid when using materials for embedment and backfill other than those identified in the Drawings. The Work performed and materials furnished in accordance with pre-bid item and measured as provided under "Measurement" will be paid for at the unit price bid per cubic yard of "Imported Embedment/Backfill" delivered to the Site for:
    a) Various embedment/backfill materials

c. The price bid shall include:
    1) Furnishing backfill or embedment as specified by this Specification
    2) Hauling to the site
    3) Placement and compaction of backfill or embedment

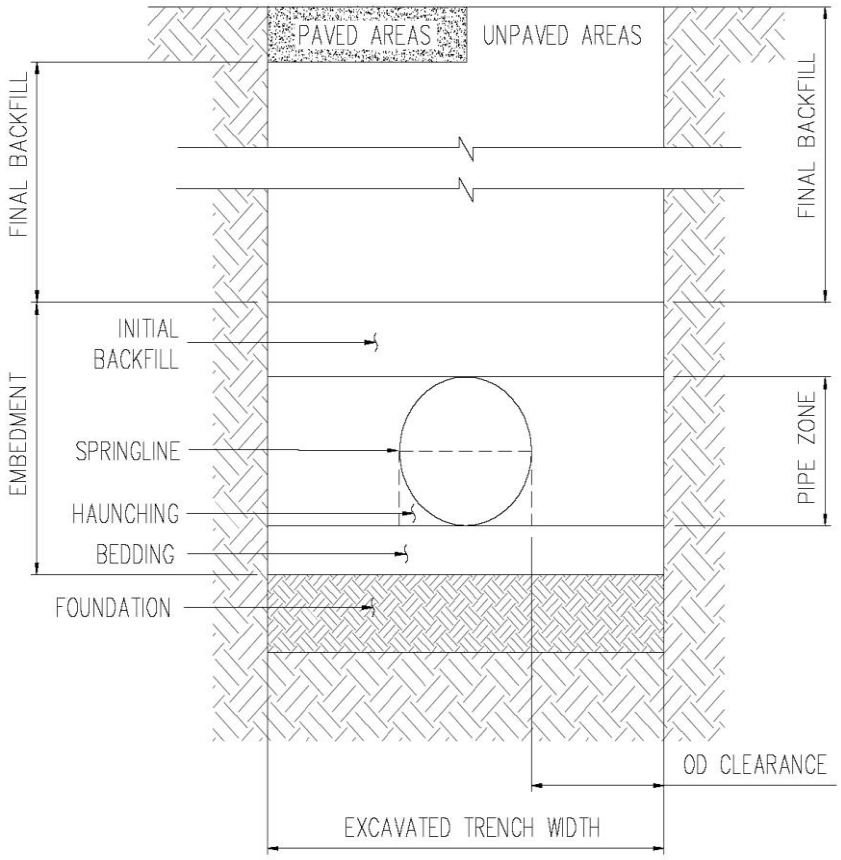
3. Concrete Encasement for Utility Lines
    a. Measurement
        1) Measured by the cubic yard per plan quantity.
    b. Payment
        1) The Work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid per cubic yard of "Concrete Encasement for Utility Lines" per plan quantity.
    c. The price bid shall include:
        1) Furnishing, hauling, placing and finishing concrete in accordance with Section 03 30 53.
        2) Clean-up
4. Ground Water Control
    a. Measurement
        1) Measurement shall be lump sum when a ground water control plan is specifically required by the Contract Documents.
    b. Payment
        1) Payment shall be per the lump sum price bid for "Ground Water Control" including:
            a) Submittals
            b) Additional Testing
            c) Ground water control system installation
            d) Ground water control system operations and maintenance
            e) Disposal of water
            f) Removal of ground water control system
5. Trench Safety
    a. Measurement
        1) Measured per linear foot of excavation for all trenches that require trench safety in accordance with OSHA excavation safety standards (29 CFR Part 1926 Subpart P Safety and Health regulations for Construction)
    b. Payment
        1) The Work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid per linear foot of excavation to comply with OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P), including, but not limited to, all submittals, labor and equipment.

1.3 REFERENCES

A. Definitions

1. General – Definitions used in this section are in accordance with Terminologies ASTM F412 and ASTM D8 and Terminology ASTM D653, unless otherwise noted.

2. Definitions for trench width, backfill, embedment, initial backfill, pipe zone, haunching bedding, springline, pipe zone and foundation are defined as shown in the following schematic:



3. Deleterious materials – Harmful materials such as clay lumps, silts and organic material
4. Excavated Trench Depth – Distance from the surface to the bottom of the bedding or the trench foundation
5. Final Backfill Depth
   a. Unpaved Areas – The depth of the final backfill measured from the top of the initial backfill to the surface
   b. Paved Areas – The depth of the final backfill measured from the top of the initial backfill to bottom of permanent or temporary pavement repair

B. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
2. ASTM Standards:
   a. ASTM C33-08 Standard Specifications for Concrete Aggregates
   b. ASTM C88-05 Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
   c. ASTM C136-01 Test Method for Sieve Analysis of Fine and Coarse Aggregate
   d. ASTM D448-08 Standard Classification for Sizes of Aggregate for Road and Bridge Construction.

e. ASTM C535-09 Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
f. ASTM D588 – Standard Test method for Moisture-Density Relations of Soil-Cement Mixture
g. ASTM D698-07 Test Method for Laboratory Compaction Characteristics of Soil Using Stand Efforts (12,400 ft-lb/ft3 600 Kn-m/M3)).
h. ASTM D 1140 - Amount of Material in Soil Finer Than the No. 200 (75m) Sieve.
i. ASTM 1556 Standard Test Methods for Density and Unit Weight of Soils in Place by Sand Cone Method.
j. ASTM 2487 – 10 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
k. ASTM 2321-09 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
l. ASTM D2922 – Standard Test Methods for Density of Soils and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
m. ASTM 3017 - Standard Test Method for Water Content of Soil and Rock in place by Nuclear Methods (Shallow Depth)
n. ASTM D4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density
o. ASTM D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
p. ASTM D 4647 - Identification and Classification of Dispersive Clay Soils by the Pinhole Test.

3. OSHA
   a. Occupational Safety and Health Administration CFR 29, Part 1926-Safety Regulations for Construction, Subpart P - Excavations

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination
1. Utility Company Notification
   a. Notify area utility companies at least 48 hours in advance, excluding weekends and holidays, before starting excavation.
   b. Request the location of buried lines and cables in the vicinity of the proposed Work.

B. Sequencing
1. Sequence Work for each section of the pipe installed to complete the embedment and backfill placement on the day the pipe foundation is complete.
2. Sequence Work such that proctors are complete in accordance with ASTM D698 prior to commencement of construction activities.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the EOR prior to construction.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Shop Drawings
1. Provide detailed drawings and explanation for ground water and surface water control, if required.
2. Trench Safety Plan in accordance with Occupational Safety and Health Administration CFR 29, Part 1926-Safety Regulations for Construction, Subpart P - Excavations
3. Stockpiled excavation and/or backfill material
   a. Provide a description of the storage of the excavated material only if the Contract Documents do not allow storage of materials in the right-of-way of the easement.

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage

1. Within Existing Rights-of-Way (ROW)
   a. Spoil, imported embedment and backfill materials may be stored within existing ROW, easements or temporary construction easements, unless specifically disallowed in the Contract Documents.
   b. Do not block drainage ways, inlets or driveways.
   c. Store materials only in areas barricaded as provided in the traffic control plans.
   d. In non-paved areas, do not store material on the root zone of any trees or in landscaped areas.
2. Designated Storage Areas
   a. If the Contract Documents do not allow the storage of spoils, embedment or backfill materials within the ROW, easement or temporary construction easement, then secure and maintain an adequate storage location.
   b. Provide an affidavit that rights have been secured to store the materials on private property.
   c. Do not block drainage ways.
   d. Only materials used for 1 working day will be allowed to be stored in the Work zone.

B. Deliveries and haul-off - Coordinate all deliveries and haul-off.

1.11 FIELD [SITE] CONDITIONS

A. Existing Conditions

1. Any data which has been or may be provided on subsurface conditions is not intended as a representation or warranty of accuracy or continuity between soils. It is expressly understood that neither the City nor the Engineer will be responsible for interpretations or conclusions drawn there from by the Contractor.
2. Data is made available for the convenience of the Contractor.

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-FURNISHED [OR] CITY-SUPPLIED PRODUCTS [NOT USED]

2.2 MATERIALS

A. Materials

1. Utility Sand
   a. Clean, Granular, and free flowing
   b. Reasonably free of mud, silt, clay lumps, clods, vegetation, or debris
   c. The material removed by decantation (Tex 406A) plus the weight of any clay lumps, shall not exceed 4.5% by weight.
   d. Gradation: sand material consisting of durable particles, free of thin or elongated pieces, lumps of clay, loam or vegetable matter and meets the following gradation may be used for utility sand embedment/backfill, and graded with following limits when tested in accordance with ASTM C136.

Sieve Size	Percent Retained
½”	0
¼”	0-5
#4	0-10

#16	0-20
#50	20-70
#100	60-90
#200	90-100

2. Crushed Rock
   a. Durable crushed rock or recycled concrete
   b. Meets the gradation of ASTM D448 size numbers 56, 57 or 67
   c. May be unwashed
   d. Free from significant silt clay or unsuitable materials
   e. Percentage of wear not more than 40 percent per ASTM C131 or C535
   f. Not more than a 12 percent maximum loss when subjective to 5 cycles of sodium sulfate soundness per ASTM C88
3. Fine Crushed Rock
   a. Durable crushed rock
   b. Meets the gradation of ASTM D448 size numbers 8 or 89
   c. May be unwashed
   d. Free from significant silt clay or unsuitable materials.
   e. Have a percentage of wear not more than 40 percent per ASTM C131 or C535
   f. Not more than a 12 percent maximum loss when subjective to 5 cycles of sodium sulfate soundness per ASTM C88
4. Ballast Stone
   a. Stone ranging from 3 inches to 6 inches in greatest dimension.
   b. May be unwashed
   c. Free from significant silt clay or unsuitable materials
   d. Percentage of wear not more than 40 percent per ASTM C131 or C535
   e. Not more than a 12 percent maximum loss when subjected to 5 cycles of sodium sulfate soundness per ASTM C88
5. Acceptable Backfill Material
   a. In-situ or imported soils classified as CL, CH, SC or GC in accordance with ASTM D2487
   b. Free from deleterious materials, boulders over 6 inches in size and organics
   c. Can be placed free from voids
   d. Must have 20 percent passing the number 200 sieve
6. Blended Backfill Material
   a. In-situ soils classified as SP, SM, GP or GM in accordance with ASTM D2487
   b. Blended with in-situ or imported acceptable backfill material to meet the requirements of an Acceptable Backfill Material
   c. Free from deleterious materials, boulders over 6 inches in size and organics
   d. Must have 20 percent passing the number 200 sieve
7. Unacceptable Backfill Material
   a. In-situ soils classified as ML, MH, PT, OL or OH in accordance with ASTM D2487
8. Select Fill
   a. Classified as SC or CL in accordance with ASTM D2487
   b. Liquid limit less than 35
   c. Plasticity index between 8 and 20
9. Cement Stabilized Sand (CSS)
   a. Sand
      1) Shall be clean and free of all foreign matter, and meeting the following graduation requirements:

Sieve Size	% Retained
1-1/4”	0-10
1/2”	10-20
3/8”	15-30
No. 4	30-65
No. 40	50-75

a) Do not use material passing the No. 40 sieve with a plasticity index greater than 10 to a liquid limit greater than 35.

b. Cement shall adhere to Section 03 30 53.
c. Water
d. Potable water, free of soils, acids, alkalis, organic matter or other deleterious substances. Water of doubtful quality shall be tested by briquette test to determine if it is equal to water of known satisfactory quality.
   1) Unless otherwise specified, use no less than 1.5 sacks of cement per ton of mixture.
   2) Use amount of water necessary to obtain optimum moisture content for mechanical tamping.
   3) Mix cement, and, and water in a mill type mixer.
e. Cement stabilized sand shall not be used after it loses its moisture content, or after it has obtained an initial set. Material not in place within 4 hours shall be rejected.

10. Controlled Low Strength Material (CLSM)
    a. Conform to Section 03 34 13
11. Trench Geotextile Fabric
    a. Soils other than ML or OH in accordance with ASTM D2487
       1) Needle punch, nonwoven geotextile composed of polypropylene fibers
       2) Fibers shall retain their relative position
       3) Inert to biological degradation
       4) Resist naturally occurring chemicals
       5) UV Resistant
       6) Mirafi 140N by Tencate, or approved equal
    b. Soils Classified as ML or OH in accordance with ASTM D2487
       1) High-tenacity monofilament polypropylene woven yarn
       2) Percent open area of 8 percent to10 percent
       3) Fibers shall retain their relative position
       4) Inert to biological degradation
       5) Resist naturally occurring chemicals
       6) UV Resistant
       7) Mirafi FW402 by Tencate, or approved equal

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION

A. Verification of Conditions

1. Review all known, identified or marked utilities, whether public or private, prior to excavation.
2. Locate and protect all known, identified and marked utilities or underground facilities as excavation progresses.
3. Notify all utility owners within the project limits 48 hours prior to beginning excavation.
4. The information and data shown in the Drawings with respect to utilities is approximate and based on record information or on physical appurtenances observed within the project limits.
5. Coordinate with the Owner(s) of underground facilities.
6. Immediately notify any utility owner of damages to underground facilities resulting from construction activities.
7. Repair any damages resulting from the construction activities.

B. Notify the City immediately of any changed condition that impacts excavation and installation of the proposed utility.

3.3 PREPARATION

A. Protection of In-Place Conditions

1. Pavement
   a. Conduct activities in such a way that does not damage existing pavement that is designated to remain.
      1) Where desired to move equipment not licensed for operation on public roads or across pavement, provide means to protect the pavement from all damage.
   b. Repair or replace any pavement damaged due to the negligence of the contractor outside the limits designated for pavement removal at no additional cost to the City.
2. Drainage
   a. Maintain positive drainage during construction and re-establish drainage for all swales and culverts affected by construction.
3. Trees
   a. When operating outside of existing ROW, stake permanent and temporary construction easements.
   b. Restrict all construction activities to the designated easements and ROW.
   c. Flag and protect all trees designated to remain.
   d. Conduct excavation, embedment and backfill in a manner such that there is no damage to the tree canopy.
   e. Prune or trim tree limbs as specifically allowed by the Drawings or as specifically allowed by the City.
      1) Pruning or trimming may only be accomplished with equipments specifically designed for tree pruning or trimming.
   f. Remove trees specifically designated to be removed in the Drawings.
4. Above ground Structures
   a. Protect all above ground structures adjacent to the construction.
   b. Remove above ground structures designated for removal in the Drawings.
5. Traffic
   a. Maintain existing traffic, except as modified by the traffic control plan.
   b. Do not block access to driveways or alleys for extended periods of time unless:
      1) Alternative access has been provided
      2) Proper notification has been provided to the property owner or resident
      3) It is specifically allowed in the traffic control plan
   c. Use traffic rated plates to maintain access until access is restored.

6. Traffic Signal – Poles, Mast Arms, Pull boxes, Detector loops
    a. Notify Streets and Traffic a minimum of 48 hours prior to any excavation that could impact the operations of an existing traffic signal.
    b. Protect all traffic signal poles, mast arms, pull boxes, traffic cabinets, conduit and detector loops.
    c. Immediately notify Streets and Traffic if any damage occurs to any component of the traffic signal due to the contractors activities.
    d. Repair any damage to the traffic signal poles, mast arms, pull boxes, traffic cabinets, conduit and detector loops as a result of the construction activities.
7. Fences
    a. Protect all fences designated to remain.
    b. Leave fence in the equal or better condition as prior to construction.

3.4 INSTALLATION

A. Excavation

1. Excavate to a depth indicated on the Drawings.
2. Trench excavations are defined as unclassified. No additional payment shall be granted for rock or other in-situ materials encountered in the trench.
3. Excavate to a width sufficient for laying the pipe in accordance with the Drawings and bracing in accordance with the Excavation Safety Plan.
4. The bottom of the excavation shall be firm and free from standing water.
    a. Notify the City immediately if the water and/or the in-situ soils do not provide for a firm trench bottom.
    b. The City will determine if any changes are required in the pipe foundation or bedding.
5. Unless otherwise permitted by the Drawings or by the City, the limits of the excavation shall not advance beyond the pipe placement so that the trench may be backfilled in the same day.
6. Over Excavation
    a. Fill over excavated areas with the specified bedding material as specified for the specific pipe to be installed.
    b. No additional payment will be made for over excavation or additional bedding material.
7. Unacceptable Backfill Materials
    a. In-situ soils classified as unacceptable backfill material shall be separated from acceptable backfill materials.
    b. If the unacceptable backfill material is to be blended in accordance with this Specification, then store material in a suitable location until the material is blended.
    c. Remove all unacceptable material from the project site that is not intended to be blended or modified.
8. Rock – No additional compensation will be paid for rock excavation or other changed field conditions.

B. Shoring, Sheeting and Bracing

1. Engage a Licensed Professional Engineer in the State of Texas to design a site specific excavation safety system in accordance with Federal and State requirements. System shall be accepted by the City prior to start of excavation.
2. Excavation protection systems shall be designed according to the space limitations as indicated in the Drawings.
3. Furnish, put in place and maintain a trench safety system in accordance with the Excavation Safety Plan and required by Federal, State or local safety requirements.

4. If soil or water conditions are encountered that are not addressed by the current Excavation Safety Plan, engage a Licensed Professional Engineer in the State of Texas to modify the Excavation Safety Plan and provide a revised submittal to the City.
5. Do not allow soil, or water containing soil, to migrate through the Excavation Safety System in sufficient quantities to adversely affect the suitability of the Excavation Protection System. Movable bracing, shoring plates or trench boxes used to support the sides of the trench excavation shall not:
   a. Disturb the embedment located in the pipe zone or lower
   b. Alter the pipe's line and grade after the Excavation Protection System is removed
   c. Compromise the compaction of the embedment located below the spring line of the pipe and in the haunching

C. Water Control

1. Surface Water
   a. Furnish all materials and equipment and perform all incidental Work required to direct surface water away from the excavation.
2. Ground Water
   a. Furnish all materials and equipment to dewater ground water by a method which preserves the undisturbed state of the subgrade soils.
   b. Do not allow the pipe to be submerged within 24 hours after placement.
   c. Do not allow water to flow over concrete until it has sufficiently cured.
   d. Engage a Licensed Engineer in the State of Texas to prepare a Ground Water Control Plan if any of the following conditions are encountered:
      1) A Ground Water Control Plan is specifically required by the Contract Documents
      2) If in the sole judgment of the City, ground water is so severe that an Engineered Ground Water Control Plan is required to protect the trench or the installation of the pipe which may include:
         a) Ground water levels in the trench are unable to be maintained below the top of the bedding
         b) A firm trench bottom cannot be maintained due to ground water
         c) Ground water entering the excavation undermines the stability of the excavation.
         d) Ground water entering the excavation is transporting unacceptable quantities of soils through the Excavation Safety System.
   e. In the event that there is no bid item for a Ground Water Control and the City requires an Engineered Ground Water Control Plan due to conditions discovered at the site, the contractor will be eligible to submit a change order.
   f. Control of ground water shall be considered subsidiary to the excavation when:
      1) No Ground Water Control Plan is specifically identified and required in the Contract Documents
   g. Ground Water Control Plan installation, operation and maintenance
      1) Furnish all materials and equipment necessary to implement, operate and maintain the Ground Water Control Plan.
      2) Once the excavation is complete, remove all ground water control equipment not called to be incorporated into the Work.
   h. Water Disposal
      1) Dispose of ground water in accordance with City policy or Ordinance.
      2) Do not discharge ground water onto or across private property without written permission.

3) Permission from the City is required prior to disposal into the Sanitary Sewer.
4) Dispose of water in accordance with NPDES permit and SWPPP.
5) Disposal shall not violate any Federal, State or local regulations.

D. Embedment and Pipe Placement
1. Water Lines less than, or equal to, 12 inches in diameter:
   a. The entire embedment zone shall be of uniform material.
   b. Utility sand shall be generally used for embedment.
   c. If ground water is in sufficient quantity to cause sand to pump, then use crushed rock as embedment.
      1) If crushed rock is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
   d. Place evenly spread bedding material on a firm trench bottom.
   e. Provide firm, uniform bedding.
   f. Place pipe on the bedding in accordance with the alignment of the Drawings.
   g. In no case shall the top of the pipe be less than 36 inches from the surface of the proposed grade, unless specifically called for in the Drawings.
   h. Place embedment, including initial backfill, to a minimum of 6 inches, but not more than 12 inches, above the pipe.
   i. Where gate valves are present, the initial backfill shall extend to 6 inches above the elevation of the valve nut.
   j. Form all blocking against undisturbed trench wall to the dimensions in the Drawings.
   k. Compact embedment and initial backfill.
   l. Place marker tape on top of the initial trench backfill in accordance with Section 33 05 91.
2. Water Lines 16-inches through 24-inches in diameter:
   a. The entire embedment zone shall be of uniform material.
   b. Utility sand may be used for embedment when the excavated trench depth is less than 15 feet deep.
   c. Crushed rock or fine crushed rock shall be used for embedment for excavated trench depths 15 feet, or greater.
   d. Crushed rock shall be used for embedment for steel pipe.
   e. Provide trench geotextile fabric at any location where crushed rock or fine crushed rock come into contact with utility sand
   f. Place evenly spread bedding material on a firm trench bottom.
   g. Provide firm, uniform bedding.
      1) Additional bedding may be required if ground water is present in the trench.
      2) If additional crushed rock is required not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
   h. Place pipe on the bedding according to the alignment shown on the Drawings.
   i. The pipe line shall be within:
      1) ±3 inches of the elevation on the Drawings for 16-inch and 24-inch water lines
   j. Place and compact embedment material to adequately support haunches in accordance with the pipe manufacturer's recommendations.
   k. Place remaining embedment including initial backfill to a minimum of 6 inches, but not more than 12 inches, above the pipe.
   l. Where gate valves are present, the initial backfill shall extend to up to the valve nut.
   m. Compact the embedment and initial backfill to 95 percent Standard Proctor ASTM D 698.

n. Density test may be performed by City to verify that the compaction of embedment meets requirements.
o. Place trench geotextile fabric on top of the initial backfill.

3. Water Lines 30-inches and greater in diameter
   a. The entire embedment zone shall be of uniform material.
   b. Crushed rock shall be used for embedment.
   c. Provide trench geotextile fabric at any location where crushed rock or fine crushed rock come into contact with utility sand.
   d. Place evenly spread bedding material on a firm trench bottom.
   e. Provide firm, uniform bedding.
      1) Additional bedding may be required if ground water is present in the trench.
      2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
   f. Place pipe on the bedding according to the alignment shown on the Drawings.
   g. The pipe line shall be within:
      1) ±1 inch of the elevation on the Drawings for 30-inch and larger water lines
   h. Place and compact embedment material to adequately support haunches in accordance with the pipe manufacturer's recommendations.
   i. For steel pipe greater than 30 inches in diameter, the initial embedment lift shall not exceed the spring line prior to compaction.
   j. Place remaining embedment, including initial backfill, to a minimum of 6 inches, but not more than 12 inches, above the pipe.
   k. Where gate valves are present, the initial backfill shall extend to up to the valve nut.
   l. Compact the embedment and initial backfill to 95 percent Standard Proctor ASTM D 698.
   m. Density test may be performed by City to verify that the compaction of embedment meets requirements.
   n. Place trench geotextile fabric on top of the initial backfill.
   o. Place marker tape on top of the trench geotextile fabric in accordance with Section 33 05 91.

4. Sanitary Sewer Lines and Storm Sewer Lines (HDPE)
   a. The entire embedment zone shall be of uniform material.
   b. Crushed rock shall be used for embedment.
   c. Place evenly spread bedding material on a firm trench bottom.
   d. Spread bedding so that lines and grades are maintained and that there are no sags in the sanitary sewer pipe line.
   e. Provide firm, uniform bedding.
      1) Additional bedding may be required if ground water is present in the trench.
      2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
   f. Place pipe on the bedding according to the alignment shown in the Drawings.
   g. The pipe line shall be within ±0.1 inches of the elevation, and be consistent with the grade shown on the Drawings.
   h. Place and compact embedment material to adequately support haunches in accordance with the pipe manufacturer's recommendations.
   i. For sewer lines greater than 30 inches in diameter, the embedment lift shall not exceed the spring line prior to compaction.

j. Place remaining embedment including initial backfill to a minimum of 6 inches, but not more than 12 inches, above the pipe.
k. Compact the embedment and initial backfill to 95 percent Standard Proctor ASTM D 698.
l. Density test may be performed by City to verify that the compaction of embedment meets requirements.
m. Place trench geotextile fabric on top of the initial backfill.
n. Place marker tape on top of the trench geotextile fabric in accordance with Section 33 05 91.

5. Storm Sewer (RCP)
   a. The bedding and the pipe zone up to the spring line shall be of uniform material.
   b. Crushed rock shall be used for embedment up to the spring line.
   c. The specified backfill material may be used above the spring line.
   d. Place evenly spread bedding material on a firm trench bottom.
   e. Spread bedding so that lines and grades are maintained and that there are no sags in the storm sewer pipe line.
   f. Provide firm, uniform bedding.
      1) Additional bedding may be required if ground water is present in the trench.
      2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
   g. Place pipe on the bedding according to the alignment of the Drawings.
   h. The pipe line shall be within ±0.1 inches of the elevation, and be consistent with the grade, shown on the Drawings.
   i. Place embedment material up to the spring line.
      1) Place embedment to ensure that adequate support is obtained in the haunch.
   j. Compact the embedment and initial backfill to 95 percent Standard Proctor ASTM D 698.
   k. Density test may be performed by City to verify that the compaction of embedment meets requirements.
   l. Place trench geotextile fabric on top of pipe and crushed rock.
6. Storm Sewer Reinforced Concrete Box
   a. Crushed rock shall be used for bedding.
   b. The pipe zone and the initial backfill shall be:
      1) Crushed rock, or
      2) Acceptable backfill material compacted to 95 percent Standard Proctor density
   c. Place evenly spread compacted bedding material on a firm trench bottom.
   d. Spread bedding so that lines and grades are maintained and that there are no sags in the storm sewer pipe line.
   e. Provide firm, uniform bedding.
      1) Additional bedding may be required if ground water is present in the trench.
      2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
   f. Fill the annular space between multiple boxes with crushed rock, CLSM.
   g. Place pipe on the bedding according to the alignment of the Drawings.
   h. The pipe shall be within ±0.1 inches of the elevation, and be consistent with the grade, shown on the Drawings.
   i. Compact the embedment initial backfill to 95 percent Standard Proctor ASTM D698.
7. Water Services (Less than 2 Inches in Diameter)

a. The entire embedment zone shall be of uniform material.
b. Utility sand shall be generally used for embedment.
c. Place evenly spread bedding material on a firm trench bottom.
d. Provide firm, uniform bedding.
e. Place pipe on the bedding according to the alignment of the Plans.
f. Compact the initial backfill to 95 percent Standard Proctor ASTM D698.

8. Sanitary Sewer Services
   a. The entire embedment zone shall be of uniform material.
   b. Crushed rock shall be used for embedment.
   c. Place evenly spread bedding material on a firm trench bottom.
   d. Spread bedding so that lines and grades are maintained and that there are no sags in the sanitary sewer pipe line.
   e. Provide firm, uniform bedding.
      1) Additional bedding may be required if ground water is present in the trench.
      2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
   f. Place pipe on the bedding according to the alignment of the Drawings.
   g. Place remaining embedment, including initial backfill, to a minimum of 6 inches, but not more than 12 inches, above the pipe.
   h. Compact the initial backfill to 95 percent Standard Proctor ASTM D698.
   i. Density test may be required to verify that the compaction meets the density requirements.

E. Trench Backfill
1. At a minimum, place backfill in such a manner that the required in-place density and moisture content is obtained, and so that there will be no damage to the surface, pavement or structures due to any trench settlement or trench movement.
   a. Meeting the requirement herein does not relieve the responsibility to damages associated with the Work.
2. Backfill Material
   a. Final backfill depth less than 15 feet
      1) Backfill with:
         a) Acceptable backfill material
         b) Blended backfill material, or
         c) Select backfill material, CSS, or CLSM when specifically required
   b. Final backfill depth 15 feet or greater: (under pavement or future pavement)
      1) Backfill depth from 0 to15 feet deep
         a) Backfill with:
            (1) Acceptable backfill material
            (2) Blended backfill material, or
            (3) Select backfill material, CSS, or CLSM when specifically required
      2) Backfill depth from 15 feet and greater
         a) Backfill with:
            (1) Select Fill
            (2) CSS, or
            (3) CLSM when specifically required
   c. Final backfill depth 15 feet or greater: (<u>not</u> under pavement or future pavement)
      1) Backfill with:
         a) Acceptable backfill material, or

b) Blended backfill material

d. Backfill for service lines:
   1) Backfill for water or sewer service lines shall be the same as the requirement of the main that the service is connected to.

3. Required Compaction and Density
   a. Final backfill (depths less than 15 feet)
      1) Compact acceptable backfill material, blended backfill material or select backfill to a minimum of 95 percent Standard Proctor per ASTM D698 at moisture content within -2 to +5 percent of the optimum moisture.
      2) CSS or CLSM requires no compaction.
   b. Final backfill (depths 15 feet and greater/under existing or future pavement)
      1) Compact select backfill to a minimum of 98 percent Standard Proctor per ASTM D 698 at moisture content within -2 to +5 percent of the optimum moisture.
      2) CSS or CLSM requires no compaction.
   c. Final backfill (depths 15 feet and greater/not under existing or future pavement)
      1) Compact acceptable backfill material blended backfill material, or select backfill to a minimum of 95 percent Standard Proctor per ASTM D 698 at moisture content within -2 to +5 percent of the optimum moisture.
4. Saturated Soils
   a. If in-situ soils consistently demonstrate that they are greater than 5 percent over optimum moisture content, the soils are considered saturated.
   b. Flooding the trench or water jetting is strictly prohibited.
   c. If saturated soils are identified in the Drawings or Geotechnical Report in the Appendix, Contractor shall proceed with Work following all backfill procedures outlined in the Drawings for areas of soil saturation greater than 5 percent.
   d. If saturated soils are encountered during Work but not identified in Drawings or Geotechnical Report in the Appendix:
      1) The Contractor shall:
         a) Immediately notify the City.
         b) Submit a Contract Claim for Extra Work associated with direction from City.
      2) The City shall:
         a) Investigate soils and determine if Work can proceed in the identified location.
         b) Direct the Contractor of changed backfill procedures associated with the saturated soils that may include:
            (1) Imported backfill
            (2) A site specific backfill design
5. Placement of Backfill
   a. Use only compaction equipment specifically designed for compaction of a particular soil type and within the space and depth limitation experienced in the trench.
   b. Flooding the trench or water setting is strictly prohibited.
   c. Place in loose lifts not to exceed 12 inches.
   d. Compact to specified densities.
   e. Compact only on top of initial backfill, undisturbed trench or previously compacted backfill.
   f. Remove any loose materials due to the movement of any trench box or shoring or due to sloughing of the trench wall.
   g. Install appropriate tracking balls for water and sanitary sewer trenches in accordance with Section 33 05 91.

6. Backfill Means and Methods Demonstration
    a. Notify the City in writing with sufficient time for the City to obtain samples and perform standard proctor test in accordance with ASTM D698.
    b. The results of the standard proctor test must be received prior to beginning excavation.
    c. Upon commencing of backfill placement for the project the Contractor shall demonstrate means and methods to obtain the required densities.
    d. Demonstrate Means and Methods for compaction including:
        1) Depth of lifts for backfill which shall not exceed 12 inches
        2) Method of moisture control for excessively dry or wet backfill
        3) Placement and moving trench box, if used
        4) Compaction techniques in an open trench
        5) Compaction techniques around structure
    e. Provide a testing trench box to provide access to the recently backfilled material.
    f. The City will provide a qualified testing lab full time during this period to randomly test density and moisture continent.
        1) The testing lab will provide results as available on the job site.
7. Varying Ground Conditions
    a. Notify the City of varying ground conditions and the need for additional proctors.
    b. Request additional proctors when soil conditions change.
    c. The City may acquire additional proctors at its discretion.
    d. Significant changes in soil conditions will require an additional Means and Methods demonstration.

3.5 REPAIR [NOT USED]

3.6 RE-INSTALLATION [NOT USED]

3.7 FIELD QUALITY CONTROL

A. Field Tests and Inspections

1. Proctors
    a. The City will perform Proctors in accordance with ASTM D698.
    b. Test results will generally be available to within 4 calendar days and distributed to:
        1) Contractor
        2) City Project Manager
        3) City Inspector
        4) Engineer
    c. Notify the City if the characteristic of the soil changes.
    d. City will perform new proctors for varying soils:
        1) When indicated in the geotechnical investigation in the Appendix
        2) If notified by the Contractor
        3) At the convenience of the City
    e. Trenches where different soil types are present at different depths, the proctors shall be based on the mixture of those soils.
2. Density Testing of Backfill
    a. Density Tests shall be in conformance with ASTM D2922.
    b. Provide a testing trench protection for trench depths in excess of 5 feet.
    c. Place, move and remove testing trench protection as necessary to facilitate all test conducted by the City.
    d. Make the excavation available for testing.
    e. The City will determine the location of the test.

f. The City hires a third-party for testing and will provide results to Contractor and the City's Inspector upon completion of the testing.
g. Test reports shall include:
    1) Location of test by station number
    2) Time and date of test
    3) Depth of testing
    4) Field moisture
    5) Dry density
    6) Proctor identifier
    7) Percent Proctor Density

3. Density of Embedment
    a. Storm sewer boxes that are embedded with acceptable backfill material, blended backfill material, cement modified backfill material or select material will follow the same testing procedure as backfill.
    b. The City may test fine crushed rock or crushed rock embedment in accordance with ASTM D2922 or ASTM 1556.

B. Non-Conforming Work
1. All non-conforming Work shall be removed and replaced.

END OF SECTION

SECTION 33 05 64

ADJUSTING GRADE OF MANHOLES, INLETS, VALVE BOXES, AND OTHER STRUCTURES TO ABOVE GRADE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vertical adjustments to manholes, inlets, valve boxes, cathodic protection test stations, and other miscellaneous structures to a new grade.

B. Related Specification Sections include but are not limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03 30 53 – Concrete
   4. Section 33 05 67 – Frame, Cover and Grade Rings.
   5. Section 33 05 06 – Utility Trench Excavation, Embedment, and Backfill.
   6. Section 33 05 84 – Gate Valve.
   7. Section 33 14 19 – Fire Hydrants.
   8. Section 33 05 60 – Precast Concrete Manholes.
   9. Section 33 05 62 – Fiberglass Manholes.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

B. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.3 REFERENCES

A. Abbreviations
   1. CLSM – Controlled Low Strength Material

B. Definitions
   1. Minor Adjustment
      a. Refers to a small elevation change, less than 6 inches, performed on an existing manhole which does not require structural modifications.
   2. Major Adjustment
      a. Refers to a significant elevation change, greater than 6 inches, performed on an existing manhole which requires structural modification.

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS [NOT USED]

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS [NOT USED]

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING [NOT USED]

1.11 FIELD CONDITIONS [NOT USED]

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-SUPPLIED PRODUCTS [NOT USED]

2.2 MATERIALS

A. Cast-in-Place Concrete
   1. In accordance with Sections 03 00 00 and 03 30 00

B. Controlled Low Strength Material (CLSM)
   1. In accordance with Section 03 34 13

C. Modifications to Existing Concrete Structures
   1. In accordance with Section 03 80 00

D. Grade Rings
   1. In accordance with Section 33 05 81

E. Frame and Cover
   1. In accordance with Section 33 05 81

F. Backfill material
   1. In accordance with Section 33 05 06

G. Water valve box extension
   1. In accordance with Section 33 14 20

H. Fire Hydrant Adjustment
   1. In accordance with Section 33 14 40

I. Cast-in-Place Concrete Manholes
   1. In accordance with Section 33 05 61

J. Precast Concrete Manholes
   1. In accordance with Section 33 05 62

K. Fiberglass Manholes
   1. In accordance with Section 33 05 76

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION

A. Verification of Conditions
   1. Examine existing structure to be adjusted for damage or defects that may affect grade adjustment.
      a. Report issue to City for consideration before beginning adjustment.

3.3 PREPARATION

A. Grade Verification
   1. For major adjustments, confirm the grade change noted on Drawings is consistent with field measurements.
      a. If not consistent, coordinate with City to verify final grade before beginning adjustment.

3.4 ADJUSTMENT

A. Manholes, Inlets, and Miscellaneous Structures

1. For sanitary sewer adjustments, replace all 24-inch frame and cover assemblies with 32-inch frame and cover assemblies.
2. Protect the bottom of structures using wood forms shaped to fit the structure to prevent debris falling into the invert, inlet, or outlet piping during adjustments.
   a. Do not use any more than a 2-piece bottom.
3. Use the least number of grade rings necessary to meet required grade.
   a. The maximum height of proposed and existing grade rings shall be no more than 18-inches for any combination of grade rings.
   b. Use least amount of grade rings necessary.
      1) For example, use 3, 4-inch rings in lieu of 6, 2-inch rings.
   c. Adjustments which result in 18-inches or more of grade rings will be considered major adjustments and will require structural modifications to existing structure to accommodate this requirement.

B. Valve Boxes
   1. Utilize standard 2-piece adjustable valve box for adjusting to final grade as shown on the Drawings/Details.

C. Fire Hydrants
   1. Limit vertical adjustments to an increase of 2 vertical feet.
   2. Decreasing grade for fire hydrants is not permitted and requires a complete replacement of fire hydrant assembly in accordance with Section 33 14 40.

D. Backfill and Grading
   1. Backfill area of excavation surrounding each adjustment in accordance with Section 33 05 06.

E. Pavement Repair
   1. If required, perform pavement repair in accordance with Section 32 01 17 or Section 32 01 29.

END OF SECTION

SECTION 33 05 91

UTILITY MARKERS, LOCATORS, AND TRACER WIRE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Buried and surface utility markers for utility construction
   2. Surface utility markers for water and sewer mains as indicated in the Drawings

B. Related Specification Sections include but are not limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.
   2. The price bid shall include:
      a. Furnishing and installing surface markers as specified in the Drawings
      b. Furnishing and installing tracer wire for all PVC and HDPE water lines and HDPE force mains
      c. Furnishing and installing detectable warning tape for all buried pipelines
      d. Continuity testing of tracer wire
      e. Replacement of non-continuous tracer wire
      f. Mobilization
      g. Pavement removal
      h. Excavation
      i. Hauling
      j. Disposal of excess material
      k. Furnishing, placement, and compaction of backfill
      l. Clean-up

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
   2. American Public Works Association (APWA):
      a. Uniform Color Code.
   3. ASTM International (ASTM):
      a. B170, Standard Specification for Oxygen-Free Electrolytic Copper – Refinery Shapes.
      b. B227, Standard Specification for Hard-Drawn Copper-Clad Steel Wire.

c. B910/B910M, Standard Specification for Annealed Copper-Clad Steel Wire.
d. B1010/B1010M, Standard Specification for Copper-Clad Steel Electrical Conductor for Tracer Wire Applications.
e. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data
1. Buried Markers
2. Surface Markers

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING [NOT USED]

1.11 FIELD CONDITIONS [NOT USED]

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-FURNISHED PRODUCTS [NOT USED]

2.2 MATERIALS

A. Manufacturers
1. Provide new Utility Markers/Locators from a manufacturer regularly engaged in the manufacturing of Utility Markers/Locators.

B. Materials
1. Buried Markers
a. Detectable Warning Tape
1) 5.0 mil overall thickness
2) Width – 3 inch minimum
3) Weight – 27.5 pounds per inch per 1,000 square feet
4) Triple Layer with:
a) Minimum thickness 0.35 mils solid aluminum foil encased in a protective inert plastic jacket

(1) 100 percent virgin low density polyethylene
(2) Impervious to all known alkalis, acids, chemical reagents, and solvents within soil
(3) Aluminum foil visible to both sides

5) Locatable by conductive and inductive methods
6) Printing encased to avoid ink rub-off
7) Color and Legends
   a) Potable water lines
      (1) Color – Blue (in accordance with APWA Uniform Color Code)
      (2) Legend – Caution Potable Water Line Below (repeated every 24 inches)
   b) Reclaimed water lines
      (1) Color – Purple (in accordance with APWA Uniform Color Code)
      (2) Legend – Caution Reclaimed Water Line Below (repeated every 24 inches)
   c) Sewer Line
      (1) Color – Green (in accordance with APWA Uniform Color Code)
      (2) Legend – Caution Sewer Line Below (repeated every 24 inches)

b. Tracer Wire and Appurtenances
   1) Tracer Wire
      a) Color
         (1) Blue for domestic water (potable) lines.
         (2) Green for sanitary sewer gravity lines and force mains.
         (3) Purple for raw and recycled water (non-potable) lines.
      b) Open Cut Installation
         (1) Copper-clad steel 12-AWG high strength, high carbon tracer wire in accordance with ASTM B170, B227, B910/910M, and B1010/1010M.
         (2) Minimum 450 lb tensile break load
         (3) Minimum 30 mils minimum high molecular-high density polyethylene jacket in accordance with ASTM D1248.
      c) Directional Bore or Carrier Pipe Installation
         (1) Two (2) Copper-clad steel 12-AWG high strength, high carbon tracer wires in accordance with ASTM B170, B227, B910/910M, and B1010/1010M.
         (2) Minimum 1,150 lb tensile break load
         (3) Minimum 45 mils high molecular-high density polyethylene jacket in accordance with ASTM D1248.
      d) Pipe Bursting Installation
         (1) 7 x 7 stranded copper-clad steel 12-AWG high strength, high carbon tracer wire in accordance with ASTM B170, B227, B910/910M, and B1010/1010M.
         (2) Minimum 4,700 lb tensile break load
         (3) Minimum 50 mils high molecular-high density polyethylene jacket in accordance with ASTM D1248.
   2) Connectors
      a) Splice along continuous runs of tracer wire for repair of a wire break, or replacement of a failed segment of wire with 3M Brand DBR Direct Bury Splice Kit or approved equal.
         (1) Provide secure connection for two or more wires.

(2) Provide moisture sealing by means of a dielectric non-hardening silicone sealant.
(3) Splice Kit shall be intended for use in direct bury applications.
(4) Rated for a minimum of 50V.

b) Branch connections for laterals, turnouts, services, and appurtenances shall utilize DryConn Direct Bury Lug Aqua, or approved equal.
(1) Provide secure connection one or two wires to the main tracer wire without cutting the main tracer wire.
(2) Provide moisture sealing by means of a dielectric non-hardening silicone sealant.
(3) Branch connector shall be intended for use in direct bury applications.
(4) Rated for a minimum of 50V.

3) Grounding
a) Grounding is required for all dead-ends/stub-outs
b) Drive-in magnesium grounding anode rod with a minimum of 20-feet of 12-AWG red HDPE insulated copper-clad steel wire connected to the rod and specifically manufactured for this purpose.

2. Surface Markers
a. Provide as follows:
1) 4-inch wide, 6-feet minimum length, fiberglass composite, double-sided marker, or approved equal
2) Posts with colored, ultraviolet resistant decals as follows:
a) Water Lines
(1) Color – Blue (in accordance with APWA Uniform Color Code)
(2) Legend – Caution Potable Water Line Below
b) Reclaimed water lines
(1) Color – Purple (in accordance with APWA Uniform Color Code)
(2) Legend – Caution Reclaimed Water Line Below
c) Sewer lines
(1) Color – Green (in accordance with APWA Uniform Color Code)
(2) Legend – Caution Sewer Line Below

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION [NOT USED]

3.4 INSTALLATION

A. Buried Markers
1. Detectable Warning Tape – For all underground water and sanitary sewer lines

a. Install in accordance with manufacturer's recommendations below natural ground surface and directly above the utility for which it is marking.
    1) Allow 18 inches minimum between utility and marker.
    2) Bury to a depth of 3 feet or as close to the grade as is practical for optimum protection and detectability.

2. Tracer Wire and Appurtenances
    a. Install tracer wire such that it can be easily accessed for connection of line tracing equipment, wire can be located without loss or deterioration of low frequency signal, and without distortion of signal caused by more than one wire being installed in close proximity to another.
    b. Install tracer wire in the same trench or inside casing with pipe during pipe installation.
        1) Secure wire to the pipe at a maximum of 5-foot intervals and in accordance with manufacturer recommendations, and the City Standard Details.
            a) Do not place the tracer wire between service saddles and the main.
        2) Securely bond all wire joints with an approved watertight connector to provide electrical continuity.
        3) Install wire at all tracer wire access points in accordance with City Standard Details, providing no less than 24-inches of coiled wire.
    c. Provide continuous tracer wire without splices from each tracer wire access point, except where approved by City for spliced-in repair or replacement connections.
    d. Install tracer wire as a continuous single wire. No looping or coiling of wire is permitted.
    e. Protect wire insulation from damage during installation of embedment and backfill.
    f. Replace all wire that has broken, cut, or damaged insulation
    g. Treat all connections between existing metallic pipe and plastic pipe as a mainline dead-end, and ground using an approved waterproof connection to a grounding anode, buried at the same depth as the tracer wire.
    h. Connect new tracer wire to an existing utility that is being extended or tied into, using approved splice connectors.
    i. At all main end caps, extend a minimum of 6 feet of tracer wire beyond the end of the pipe, coil, and secured to the pipe for future connections. Splice the end of the tracer wire to a grounding rod in accordance with manufacturer's recommendations and City Standard Details and bury grounding rod at the same elevation as the main.
    j. Place tracer wire access valve boxes spaced in accordance with City Standard Details.

B. Surface Markers
    1. Bury a minimum of 2 feet deep, with a minimum of 4 feet above ground
    2. The warning sign for all surface markers shall be 21 inches (not including decaled portion).
    3. Place surface markers near fixed objects, if possible
    4. Place Surface Markers at the following locations:
        a. Unimproved areas only
        b. Buried Features
            1) Place directly above a buried feature.
        c. Above-Ground Features
            1) Place a maximum of 2 feet away from an above-ground feature.
        d. Water lines 12-inches and larger:

1) Each right-of-way line (or end of casing pipe) for:
   a) Highway crossings
   b) Railroad crossings
2) Utility crossings such as:
   a) High pressure or large diameter gas lines
   b) Fiber optic lines
   c) Underground electric transmission lines
   d) Or other locations specified in the Drawings or directed by the City

e. For sanitary sewer lines:
   1) In undeveloped areas, place marker maximum of 2 feet away from an above-ground feature such as a manhole or combination air valve vault.
f. Place at 500-foot intervals along the pipeline.
g. As specified in Drawings.

3.5 REPAIR [NOT USED]

3.6 RE-INSTALLATION [NOT USED]

3.7 FIELD QUALITY CONTROL

A. Testing
   1. After all trench backfill is completed and prior to final surface repair, perform continuity and trace tests on all tracer wire in the presence of the City.
   2. If the tracer wire is found to be non-continuous after testing, repair or replace the failed segment of wire.

3.8 SYSTEM STARTUP [NOT USED]

3.9 ADJUSTING [NOT USED]

3.10 CLEANING [NOT USED]

3.11 CLOSEOUT ACTIVITIES [NOT USED]

3.12 PROTECTION [NOT USED]

3.13 MAINTENANCE [NOT USED]

3.14 ATTACHMENTS [NOT USED]

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 33 11 10
Ductile Iron Pipe

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Section Includes:

1. Ductile Iron Pipe 3-inch through 64-inch for potable water, wastewater and reuse applications

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Procurement and Contracting Requirements
2. Division 01 – General Requirements

1.02 REFERENCES:

A. Definitions

1. Gland or Follower Gland
   a) Non-restrained, mechanical joint fitting
2. Retainer Gland
   a) Mechanically restrained mechanical joint fitting

B. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification unless a date is specifically cited.
2. American Association of State Highway and Transportation Officials (AASHTO).
3. American Society of Mechanical Engineers (ASME):
   a) B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250).
4. ASTM International (ASTM):
   a) A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
   b. A194, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
5. A242, Standard Specification for High-Strength Low-Alloy Structural Steel.
   a) A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi
      Tensile Strength.
   b) A674, Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
   c) B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
6. American Water Works Association (AWWA):

a) C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
b) C600, Installation of Ductile-Iron Water Mains and their Appurtenances.
c) M41, Ductile-Iron Pipe and Fittings.

7. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a) C104/A21.4, Cement–Mortar Lining for Ductile-Iron Pipe and Fittings.
   b) C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   c) C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   d) C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   e) C150/A21.50, Thickness Design of Ductile-Iron Pipe.
   f) C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
   g) C600, Installation of Ductile-Iron Water Mains and their Appurtenances
8. NSF International (NSF):
   a) 61, Drinking Water System Components - Health Effects.
9. Society for Protective Coatings (SSPC):
   a) PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.

1.03 SUBMITTALS:

A. Submittals shall be in accordance with Section 01 33 23.
B. All submittals shall be approved by the Owner prior to delivery and/or fabrication for specials.

1.04 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS:

A. Product Data
   1. Interior lining
      a) If it is other than cement mortar lining in accordance with AWWA/ANSI
      b) C104/A21.4, including:
         i) Material
         ii) Application recommendations
         iii) Field touch-up procedures
         iv) Thrust Restraint
         v) Retainer glands, thrust harnesses or any other means
      c) Gaskets
         i) If hydrocarbon or other special gaskets are required
      d) Certificates
         i) Furnish an affidavit certifying that all Ductile Iron Pipe meets the provisions of this Section, each run of pipe furnished has met Specifications, all inspections have been made, and that all tests have been performed in accordance with AWWA/ANSI C151/A21.51.

1.05 QUALITY ASSURANCE:

A. Qualifications

1. Manufacturers
   a) Finished pipe shall be the product of 1 manufacturer.
      i) Change orders, specials, and field changes may be provided by a different manufacturer upon Owner approval.
      ii) Pipe manufacturing operations (pipe, lining, and coatings) shall be performed under the control of the manufacturer.
      iii) Ductile Iron Pipe
      iv) Manufactured in accordance with AWWA/ANSI C151/A21.51
         1. Perform quality control tests and maintain results as outlined within standard to assure compliance.
         2. Subject each pipe to a hydrostatic test of not less than 500 psi for duration of at least 10 seconds.
2. Preconstruction Testing
   a) The Owner may, at its own cost, subject random lengths of pipe for testing by an independent laboratory for compliance with this Specification.
      i) The compliance test shall be performed in the United States.
      ii) Any visible defects or failure to meet the quality standards herein will be grounds for rejecting the entire order.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Storage and Handling Requirements

1. Ductile Iron Pipe shall be stored and handled in accordance with the guidelines as stated in AWWA M41.
2. Secure and maintain a location to store the material in accordance with Section 01 52 00.

PART 2 PRODUCTS

2.01 EQUIPMENT, PRODUCT TYPES AND MATERIALS:

A. Manufacturers

1. Restrained joint pipe shall be the Flex-Ring® Joint or the Lok-Ring® Joint as manufactured by American Ductile Iron Pipe Company, TR Flex® Joint as U.S. Pipe Company, or approved equal.

B. Pipe

1. Pipe shall be in accordance with AWWA/ANSI C111/A21.11, AWWA/ANSI C150/A21.15, and AWWA/ANSI C151/A21.51.
2. All pipe shall meet the requirements of NSF 61.
3. Pipe shall have a lay length of 18 feet or 20 feet except for special fittings or closure pieces and necessary to comply with the Drawings.

4. As a minimum the following pressures classes apply. The Drawings may specify a higher-pressure class or the pressure and deflection design criteria may also require a higher pressure class, but in no case should they be less than the following:

Diameter (inches)	Min Pressure Class (psi)
3 through 12	350
14 through 30	250

5. Pipe markings shall meet the minimum requirements of AWWA/ANSI C151/A21.51. Minimum pipe markings shall be as follows:
   a) "DI" or "Ductile" shall be clearly labeled on each pipe
   b) Weight, pressure class and nominal thickness of each pipe
   c) Year and country pipe was cast
   d) Manufacturer's mark
6. Provisions for Thrust
   a) Thrust at bends, tees, plugs or other fittings shall be mechanically restrained joints when required by the Drawings.
   b) Restrained joints, when required, shall be used for a sufficient distance from each
      side of the bend, tee, plug, valve, or other fitting to resist thrust which will be developed at the design pressure of the pipe. To thrust, the following shall apply:
      i) Valves shall be calculated as dead ends.
      ii) Design pressure shall be greater than the working pressure of the pipe or the internal pressure (Pi) whichever is greater.
      iii) Restrained joints shall consist of approved mechanical restrained or push-on restrained joints.
   c) The Pipe Manufacturer shall verify the length of pipe with restrained joints to resist thrust in accordance with the Drawings, AWWA M41, and the following:
      i) The weight of earth (We) shall be calculated as the weight of the projected soil prism above the pipe, for unsaturated soil conditions.
      ii) Soil density = 130 pcf (maximum value to be used), for unsaturated soil conditions
      iii) If indicated on the Drawings and the Geotechnical Borings that ground water is expected, account for reduced soil density.

C. Joints
   1. General – Comply with AWWA/ANSI C111/A21.11.
   2. Push-On Joints

3. Mechanical Joints
4. Push-On Restrained Joints
5. Restraining Push-on joints by means of a special gasket
6. The working pressure rating of the restrained gasket must exceed the test pressure of the pipeline to be installed. Otherwise only approved if specially listed on the Drawings

D. Push-on Restrained Joint bell and spigot
   1. Pressure rating shall exceed the working and test pressure of the pipe line.
   2. Flanged Joints – AWWA/ANSI C115/A21.15, ASME B16.1, Class 125
   3. Flange bolt circles and bolt holes shall match those of ASME B16.1, Class 125.
   4. Field fabricated flanges are prohibited.

E. Gaskets
   1. Mechanical Joints and Push-on gaskets
      a) Conforming to the physical and marking requirements specified in ANSI/AWWA C111/A21.11.
      b) All gaskets shall meet or exceed the latest revisions NSF 61.
      c) Rubber gaskets shall be made of vulcanized styrene butadiene rubber SBR, unless otherwise specified in Drawings.
      d) Gaskets shall be the size and shape required to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal under all combinations of joint and gasket tolerances.
      e) Flange Gaskets
         i) Full face
         ii) Manufactured true to shape from minimum 80 durometer SBR rubber stock
         of a thickness not less than 1/8 inch
         iii) Virgin stock
         iv) Conforming to the physical and test requirements specified in AWWA/ANSI C111/A21.11
         v) All gaskets shall meet or exceed the latest revisions NSF 61.
         vi) Finished gaskets shall have holes punched by the manufacturer and shall match the flange pattern in every respect.
         vii) Frayed cut edges are not acceptable.
         viii) Field cut sheet gaskets are not acceptable.

F. Isolation Flanges
   1. Required applications of dielectric flange isolation assemblies include, but are not limited to, selected locations where new piping is mechanically connected to existing piping and when joining two pipes of dissimilar metals.
   2. Gasket
      a) Isolating and seal gasket
      b) G-10 Epoxy Glass material

c) Full face
d) 1/8-inch thickness
e) Use with a minimum of 1 EDPM sealing element placed in a tapered groove.
f) NSF 61 certified
g) A minimum of 800 volts/mil dielectric strength is required.
h) Flange shall seal for the test pressure without leaking.

3. Sleeves
   a) Provide full length mylar sleeves
4. Washers
   a) Provide double G-10 washer sets.

G. Bolts and Nuts
1. Mechanical Joints
   a) All bolts and nuts shall be 304 Stainless Steel.

H. Flanged Ends
1. Meet requirements of AWWA C115.
   a) All bolts and nuts shall be 304 Stainless Steel.

I. Threaded Rods
1. All threaded rods shall be 304 Stainless Steel.

J. Ductile Iron Pipe Exterior Coatings
1. All ductile iron shall have an asphaltic coating, minimum of 1 mil thick, on the pipe exterior, unless otherwise specified in the Contract Documents.

K. Polyethylene Encasement
1. All buried Ductile Iron Pipe shall be polyethylene encased.
2. Use only virgin polyethylene material.
3. Encasement for buried pipe shall be 8 mil linear low density (LLD) polyethylene conforming to AWWA/ANSI C105/A21.5 or 4 mil high density cross-laminated
   (HDCL) polyethylene encasement conforming to AWWA/ANSI C105/A21.5 and
   ASTM A674.
4. Marking: At a minimum of every 2 feet along its length, the mark the polyethylene film with the following information:
   a) Manufacturer's name or trademark
   b) Year of manufacturer
   c) AWWA/ANSI C105/A21.5
   d) Minimum film thickness and material type
   e) Applicable range of nominal diameter sizes
   f) Warning – Corrosion Protection – Repair Any Damage
5. Special Markings/Colors
   a) Reclaimed Water, perform one of the following:
      i) Label polyethylene encasement with "RECLAIMED WATER",
      ii) Provide purple polyethylene in accordance with the American Public Works Association Uniform Color Code; or

iii) Attach purple reclaimed water marker tape to the polyethylene wrap.

b) Wastewater, perform one of the following:

i) Label polyethylene encasement with "WASTEWATER"

ii) Provide green polyethylene in accordance with the American Public Works Association Uniform Color Code; or

iii) Attach green sanitary sewer marker tape to the polyethylene wrap.

6. Minimum widths

Polyethylene Tube and Sheet Sizes for Push-On Joint Pipe

Nominal Pipe Diameter (inches)	Min. Width-Flat Tube (inches)	Min. Width-Sheet (inches)
3	14	28
4	14	28
6	16	32
8	20	40
10	24	48
12	27	54
14	30	60
16	34	68
18	37	74
20	41	82
24	54	108
30	67	134
36	81	162
42	81	162
48	95	190
54	108	216
60	108	216
64	121	242

L. Ductile Iron Pipe Interior Lining

1. Cement Mortar Lining

a) Ductile Iron Pipe for potable water shall have a cement mortar lining in accordance with AWWA/ANSI C104/A21.04 and be acceptable according to NSF 61.

M. Ceramic Epoxy or Epoxy Linings

1. Ductile Iron Pipe for use in wastewater applications shall be lined with a Ceramic Epoxy or Epoxy lining as specified in the plans.
2. Apply lining at a minimum of 40 mils DFT.
3. Due to the tolerances involved, the gasket area and spigot end up to 6

inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum using a Joint Compound as supplied by the manufacturer.
   a) Apply the joint compound by brush to ensure coverage.
   b) Care should be taken that the joint compound is smooth without excess buildup in the gasket seat or on the spigot ends.
   c) Coat the gasket seat and spigot ends after the application of the lining.
4. Surface preparation shall be in accordance with the manufacturer's recommendations.
5. Check thickness using a magnetic film thickness gauge in accordance with
   the method outlined in SSPC PA 2.
6. Test the interior lining of all pipe barrels for pinholes with a non-destructive
   2,500-volt test.
7. Repair any defects prior to shipment.
8. Mark each fitting with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by
   the applicator of his work.
9. For all Ductile Iron Pipe in wastewater service where the pipe has been cut,
   coat the exposed surface with the touch-up material as recommended by the
   manufacturer.
   a) The touch-up material and the lining shall be of the same manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. General
   1. Install pipe, fittings, specials, and appurtenances as specified herein, as specified in AWWA C600, AWWA M41 and in accordance with the pipe manufacturer's
      recommendations.
   2. See Section 33 11 11 for installation requirements for Ductile Iron Fittings.
   3. Lay pipe to the lines and grades as indicated in the Drawings.

B. Pipe Handling
   1. Haul and distribute pipe and fittings at the project site.
   2. Handle piping with care to avoid damage.
      a) Inspect each joint of pipe and reject or repair any damaged pipe prior to lowering
         into the trench.

b) Do not handle the pipe in such a way that will damage the interior lining.
c) Use only nylon ropes, slings or other lifting devices that will not damage the surface of the pipe for handling the pipe.

3. At the close of each operating day:

a) Keep the pipe clean and free of debris, dirt, animals and trash – during and after the laying operation.
b) Effectively seal the open end of the pipe using a gasketed night cap.

C. Joint Making
1. Mechanical Joints
a) Bolt the follower ring into compression against the gasket with the bolts tightened down evenly then cross torqued in accordance with AWWA C600.
b) Overstressing of bolts to compensate for poor installation practice will not be permitted.
2. Push-on Joints
a) Install Push-on joints as defined in AWWA/ANSI C111/A21.11.
b) Wipe clean the gasket seat inside the bell of all extraneous matter.
c) Place the gasket in the bell in the position prescribed by the manufacturer.
d) Apply a thin film of non-toxic vegetable soap lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell.
e) When using a field cut plain end piece of pipe, refinish the field cut and scarf to conform to AWWA C600.
3. Flanged Joints
a) Use erection bolts and drift pins to make flanged connections.
i) Do not use undue force or restraint on the ends of the fittings.
b) Apply even and uniform pressure to the gasket.
i) The fitting must be free to move in any direction while bolting.
1) Install flange bolts with all bolt heads faced in one direction.
4. Joint Deflection
a) Deflect the pipe only when necessary to avoid obstructions or to meet the lines and grades and shown in the Drawings.
b) The deflection of each joint must be in accordance with AWWA C600 Table 3.
c) The maximum deflection allowed is 50 percent of that indicated in AWWA C600.
d) The manufacturer's recommendation may be used with the approval of the Engineer.

D. Polyethylene Encasement Installation
1. Preparation
a) Remove all lumps of clay, mud, cinders, etc., on pipe surface prior to installation of polyethylene encasement.
i) Prevent soil or embedment material from becoming trapped between pipe
and polyethylene.

b) Fit polyethylene film to contour of pipe to affect a snug, but not tight encase with
minimum space between polyethylene and pipe.
   i) Provide sufficient slack in contouring to prevent stretching polyethylene where it bridges irregular surfaces such as bell-spigot interfaces, bolted joints or fittings and to prevent damage to polyethylene due to backfilling operations.
   ii) Secure overlaps and ends with adhesive tape and hold.

c) For installations below water table and/or in areas subject to tidal actions, seal both ends of polyethylene tube with adhesive tape at joint overlap.

2. Tubular Type (Method A)
   a) Cut polyethylene tube to length approximately 2 feet longer than pipe section.
   b) Slip tube around pipe, centering it to provide 1-foot overlap on each adjacent pipe section and bunching it accordion-fashion lengthwise until it clears pipe ends.
   c) Lower pipe into trench and make up pipe joint with preceding section of pipe.
   d) Make shallow bell hole at joints to facilitate installation of polyethylene tube.
   e) After assembling pipe joint, make overlap of polyethylene tube, pull bunched polyethylene from preceding length of pipe, slip it over end of the new length of
   pipe and wrap until it overlaps joint at end of preceding length of pipe.
   f) Secure overlap in place.
   g) Take up slack width at top of pipe to make a snug, but not tight, fit along barrel of pipe, securing fold at quarter points.
   h) Repair cuts, tears, punctures, or other damage to polyethylene.
   i) Proceed with installation of next pipe in same manner.
3. Tubular Type (Method B)
   a) Cut polyethylene tube to length approximately 1 foot shorter than pipe section.
   b) Slip tube around pipe, centering it to provide 6 inches of bare pipe at each end.
   c) Take up slack width at top of pipe to make a snug, but not tight, fit along barrel of pipe, securing fold at quarter points; secure ends.
   d) Before making up joint, slip 3-foot length of polyethylene tube over end of proceeding pipe section, bunching it accordion-fashion lengthwise.
   e) After completing joint, pull 3-foot length of polyethylene over joint, overlapping
   polyethylene previously installed on each adjacent section of pipe by at least 1
   foot; make each end snug and secure.
4. Sheet Type

a) Cut polyethylene sheet to a length approximately 2 feet longer than piece section.
b) Center length to provide 1-foot overlap on each adjacent pipe section, bunching it
until it clears the pipe ends.
c) Wrap polyethylene around pipe so that it circumferentially overlaps top quadrant
of pipe.

d) Secure cut edge of polyethylene sheet at intervals of approximately 3 feet.

e) Lower wrapped pipe into trench and make up pipe joint with preceding section of pipe.
f) Make shallow bell hole at joints to facilitate installation of polyethylene.
g) After completing joint, make overlap and secure ends.
h) Repair cuts, tears, punctures, or other damage to polyethylene.
i) Proceed with installation of next section of pipe in same manner.

5. Pipe-Shaped Appurtenances
   a) Cover bends, reducers, offsets and other pipe-shaped appurtenances with polyethylene in same manner as pipe and fittings.
6. Odd-Shaped Appurtenances
   a) When it is not practical to wrap valves, tees, crosses, and other odd-shaped pieces
   in tube, wrap with flat sheet or split length polyethylene tube by passing sheet under appurtenances and bringing it up around body.
   b) Make seams by bringing edges together, folding over twice and taping down.
   c) Tape polyethylene securely in place at the valve stem and at any other penetrations.
7. Repairs
   a) Repair any cuts, tears, punctures or damage to polyethylene with adhesive tape or
   with short length of polyethylene sheet or cut open tube, wrapped around fitting
   to cover damaged area and secured in place.
8. Openings in Encasement
   a) Provide openings for branches, service taps, blow-offs, air valves and similar appurtenances by making an X-shaped cut in polyethylene and temporarily folding back film.
   b) After appurtenance is installed, tape slack securely to appurtenance and repair cut, as well as other damaged area in polyethylene with tape.
   c) Service taps may also be made directly through polyethylene, with any resulting
   damaged areas being repaired as described above.

9. Junctions between Wrapped and Unwrapped Pipe:
    a) Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend polyethylene wrap to cover adjacent pipe for distance of at least 3 feet.
    b) Secure end with circumferential turns of tape.
    c) Wrap service lines of dissimilar metals with polyethylene or suitable dielectric tape for minimum clear distance of 3 feet away from Cast or Ductile Iron Pipe.

3.02 REPAIR/RESTORATION

A. Patching
    1. Excessive field-patching is not permitted of lining or coating.
    2. Patching of lining or coating will be allowed where area to be repaired does not exceed 100 square inches and has no dimensions greater than 12 inches.
    3. In general, there shall not be more than 1 patch on either the lining or the coating of
    any 1 joint of pipe.
    4. Wherever necessary to patch the pipe:
        a) Make patch with cement mortar as previously specified for interior joints.
        b) Do not install patched pipe until the patch has been properly and adequately cured and approved for laying by the Owner.
    5. Promptly remove rejected pipe from the site.

END OF SECTION

SECTION 33 11 11
DUCTILE IRON FITTINGS

A.

B. PART 1 GENERAL

1.01 SUMMARY

C. Section Includes:

1. Ductile Iron Fittings 3-inch through 64-inch for potable water, wastewater, and other liquids for use with Ductile Iron Pipe and Polyvinyl Chloride (PVC) Pipe
2. All mechanical joint fittings shall be mechanically restrained using restrained wedge type retainer glands.

D. Related Specification Sections include, but are not necessarily limited to:

1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract
2. Division 1 – General Requirements
3. Section 03 30 00 – Cast-in-Place Concrete
4. Section 33 11 05 – Bolts, Nuts, and Gaskets

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Ductile Iron Water Fittings with Restraint

B. Measurement

1. Shall be per ton of fittings supplied
2. Fittings weights are the sum of the various types of fittings multiplied by the weight per fitting as listed in AWWA/ANSI C153/A21.53.
3. The fitting weights listed in AWWA/ANSI C110/A21.10 are only allowed for specials where an AWWA/ANSI C153/A21.53 is not available, or if the Drawings specifically call for an AWWA/ANSI C110/A21.10 fittings.
4. If the Contractor chooses to supply AWWA/ANSI C110/A21.10 (full body) Ductile Iron Fittings in lieu of AWWA/ANSI C153/A21.53 (compact) Ductile Iron Fittings at his convenience, then the weight shall be measured in accordance with AWWA/ANSI C153/A21.53.

C. Payment

1. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid per ton of “Ductile Iron Water Fittings with Restraint”.

D. The price bid shall include:

1. Furnishing and installing Ductile Iron Water Fittings as specified by the Drawings
2. Polyethylene encasement
3. Lining
4. Pavement removal
5. Excavation
6. Hauling
7. Disposal of excess material
8. Furnishing and installing bolts, nuts, and restraints
9. Furnishing, placement and compaction of embedment

10. Furnishing, placement and compaction of backfill
11. Trench water stops
12. Clean-up
13. Cleaning
14. Disinfection
15. Testing

1.03 REFERENCES

A. Definitions

1. Gland or Follower Gland
   a. Non-restrained, mechanical joint fitting
2. Retainer Gland
   a. Mechanically restrained mechanical joint fitting, consisting of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.

1.04 REFERENCE STANDARDS

A. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.

1. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
2. ASTM International (ASTM):
   a. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
   b. A194, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
   c. A242, Standard Specification for High-Strength Low-Alloy Structural Steel.
   d. A674, Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
   e. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
3. American Water Works Association (AWWA):
   a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
   b. C600, Installation of Ductile-Iron Water Mains and their Appurtenances.
   c. M41, Ductile-Iron Pipe and Fittings.
4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a. C104/A21.4, Cement–Mortar Lining for Ductile-Iron Pipe and Fittings.
   b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
   d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   f. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
   g. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
5. NSF International (NSF):
   a. 61, Drinking Water System Components - Health Effects.
6. Society for Protective Coatings (SSPC):

a. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.

1.05 SUBMITTALS

B. Submittals shall be in accordance with Section 01 33 00.

C. All submittals shall be approved by the Owner prior to delivery and/or fabrication for specials.

1.2 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

1.01 PRODUCT DATA

A. Ductile Iron Fittings
   a. Pressure class
   b. Interior lining
   c. Joint types

B. Polyethylene encasement and tape
   a. Planned method of installation
   b. Whether the film is linear low density or high density cross linked polyethylene
   c. The thickness of the film provided

C. The interior lining, if it is other than cement mortar lining in accordance with AWWA/ANSI C104/A21.4
   a. Material
   b. Application recommendations
   c. Field touch-up procedures

D. Thrust Restraint
   a. Retainer glands
   b. Thrust harnesses
   c. Any other means

E. Gaskets
   a. Provide Gaskets in accordance with Section 33 11 05.

2. Isolation Flanges
   a. Flanges required by the drawings to be Isolation Flanges shall conform to Section 33 04 10.

3. Bolts and Nuts
   a. Mechanical Joints
      1) Provide bolts and nuts in accordance with Section 33 11 05.
   b. Flanged Ends
      1) Meet requirements of AWWA C115.
         a) Provide bolts and nuts in accordance with Section 33 11 05.

4. Flange Coatings
   a. Connections to Steel Flanges
      1) Buried connections with Steel Flanges shall be coated with a Petrolatum Tape System in accordance with Section 33 11 05.

1.02 CERTIFICATES

A. The manufacturer shall furnish an affidavit certifying that all Ductile Iron Fittings meet the provisions of this Section and meet the requirements of AWWA/ANSI C110/A21.10 or AWWA/ANSI C153/A21.53.

B. Furnish a certificate stating that buried bolts and nuts conform to ASTM B117.

1.03 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturers
      a. Fittings manufacturing operations (fittings, lining, and coatings) shall be performed under the control of the manufacturer.
      b. Ductile Iron Fittings shall be manufactured in accordance with AWWA/ANSI C110/A21.10 or AWWA/ANSI C153/A21.53.
      c. Perform quality control tests and maintain the results as outlined in these standards to assure compliance.

B. Preconstruction Testing
   1. The Owner may, at its own cost, subject random fittings for destructive testing by an independent laboratory for compliance with this Specification.
      a. The compliance test shall be performed in the United States.
      b. Any visible defects or failure to meet the quality standards herein will be grounds for rejecting the entire order.

1.04 DELIVERY, STORAGE, AND HANDLING

C. Storage and Handling Requirements
   1. Store and handle in accordance with the guidelines as stated in AWWA M41.
   2. Secure and maintain a location to store the material in accordance with Section 01 66 00.

PART 2 - PRODUCTS

1.05 EQUIPMENT, PRODUCT TYPES AND MATERIALS

A. Manufacturers
   1. MJ Solid Sleeve Couplings shall be Style A11760, and MJ Transition Sleeve Couplings shall be Style A10766, as manufactured by American Cast Iron Pipe Co., or equal.
   2. Dresser Piping Specialties.
   3. Ebaa Iron Sales, Inc.
   4. Star Pipe Products, Inc.
   5. Company specializing in manufacturing products specified in this Section with minimum 3 years experience.
   6. Any product that is not listed on the Standard Products List is considered a substitution and shall be submitted in accordance with Section 01 25 00.

B. Ductile Iron Fittings
   1. Ductile Iron Fittings shall be in accordance with AWWA/ANSI C110/A21.10, AWWA/ANSI C153/A21.53.
   2. All fittings for potable water service shall meet the requirements of NSF 61.
   3. Ductile Iron Fittings, at a minimum, shall meet or exceed the pressures classes of the pipe which the fitting is connected, unless specifically indicated in the Drawings.
   4. Fittings Markings
      a. Meet the minimum requirements of AWWA/ANSI C151/A21.51.
      b. Minimum markings shall include:
         1) “DI” or “Ductile” cast or metal stamped on each fitting
         2) Applicable AWWA/ANSI standard for that the fitting
         3) Pressure rating
         4) Number of degrees for all bends
         5) Nominal diameter of the openings

6) Year and country fitting was cast
7) Manufacturer's mark

5. Joints
   a. Mechanical Joints with mechanical restraint
      1) Comply with AWWA/ANSI C111/A21.11 and applicable parts of ANSI/AWWA C110/A21.10.
      2) The retainer gland shall have the following working pressure ratings based on size and type of pipe:
         a) Ductile Iron Pipe
            (1) 3-inch – 16-inch, 350 psi
            (2) 18-inch – 48-inch, 250 psi
         b) PVC C900 and C905
            (1) 3-inch – 12-inch, 305psi
            (2) 14-inch – 16-inch, 235psi
            (3) 18-inch – 20-inch, 200psi
            (4) 24-inch – 30 –inch 165psi
         c) Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes
      3) Retainer glands shall have specific designs for Ductile Iron and PVC and should be easily differentiate between the 2.
      4) Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
      5) Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly.
      6) Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
   b. Push-On, Restrained Joints
      1) Restraining Push-on joints by means of a special gasket
         a) Only those products that are listed in 01 60 00
         b) The working pressure rating of the restrained gasket must exceed the test pressure of the pipe line to be installed.
         c) Approved for use of restraining Ductile Iron Pipe in casing with a carrier pipe of 4-inches to 12-inches
         d) Otherwise only approved if specially listed on the drawings
      2) Push-on Restrained Joint bell and spigot
         a) Only those products list in the standard products list will be allowed for the size listed in the standard products list per Section 01 60 00
         b) Pressure rating shall exceed the working and test pressure of the pipe line
   c. Flanged Joints
      1) AWWA/ANSI C115/A21.15, ASME B16.1, Class 250
      2) Flange bolt circles and bolt holes shall match those of ASME B16.1, Class 250.
      3) Field fabricated flanges are prohibited.
6. Gaskets
   a. Provide Gaskets in accordance with Section 33 11 05.
7. Isolation Flanges

a. Flanges required by the drawings to be Isolation Flanges shall conform to Section 33 04 10.

8. Bolts and Nuts
   a. Mechanical Joints
      1) Provide bolts and nuts in accordance with Section 33 11 05.
   b. Flanged Ends
      1) Meet requirements of AWWA C115.
         a) Provide bolts and nuts in accordance with Section 33 11 05.
9. Flange Coatings
   a. Connections to Steel Flanges
      1) Buried connections with Steel Flanges shall be coated with a Petrolatum Tape System in accordance with Section 33 11 05.
10. Ductile Iron Fitting Exterior Coatings
    a. All Ductile Iron Fittings shall have an asphaltic coating, minimum of 1 mil thick, on the exterior, unless otherwise specified in the Contract Documents.
11. Polyethylene Encasement
    a. All buried Ductile Iron Fittings shall be polyethylene encased.
    b. Only manufacturers listed in the Owner's Standard Products List as shown in Section 01 60 00 will be considered acceptable.
    c. Use only virgin polyethylene material.
    d. Encasement for buried fittings shall be 8 mil linear low density (LLD) polyethylene conforming to AWWA/ANSI C105/A21.5 or 4 mil high density cross-laminated (HDCL) polyethylene encasement conforming to conforming to AWWA/ANSI C105/A21.5 and ASTM A674.
    e. Marking: At a minimum of every 2 feet along its length, the mark the polyethylene film with the following information:
       1) Manufacturer's name or trademark
       2) Year of manufacturer
       3) AWWA/ANSI C105/A21.5
       4) Minimum film thickness and material type
       5) Applicable range of nominal diameter sizes
       6) Warning – Corrosion Protection – Repair Any Damage
    f. Special Markings/Colors
       1) Reclaimed Water, perform one of the following:
          a) Label polyethylene encasement with "RECLAIMED WATER",
          b) Provide purple polyethylene in accordance with the American Public Works Association Uniform Color Code; or
          c) Attach purple reclaimed water marker tape to the polyethylene wrap.
       2) Wastewater, perform one of the following:
          a) Label polyethylene encasement with "WASTEWATER";
          b) Provide green polyethylene in accordance with the American Public Works Association Uniform Color Code; or
          c) Attach green sanitary sewer marker tape to the polyethylene wrap.
    g. Minimum widths

Polyethylene Tube and Sheet Sizes for Push-On Joint Fittings

Nominal Fittings Diameter (inches)	Min. Width – Flat Tube (inches)	Min. Width – Sheet (inches)

3	14	28
4	14	28
6	16	32
8	20	40
10	24	48
12	27	54
14	30	60
16	34	68
18	37	74
20	41	82
24	54	108
30	67	134
36	81	162
42	81	162
48	95	190
54	108	216
60	108	216
64	121	242

12. Ductile Iron Fittings Interior Lining
    a. Cement Mortar Lining
        1) Ductile Iron Fittings for potable water shall have a cement mortar lining in accordance with AWWA/ANSI C104/A21.4 and be acceptable according to NSF 61.
    b. Ceramic Epoxy or Epoxy Linings
        1) Ductile Iron Fittings for use in wastewater applications shall be lined with a Ceramic Epoxy or Epoxy lining as designated in the Standard Products List as shown in Section 01 60 00.
        2) Apply lining at a minimum of 40 mils DFT
        3) Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum using a Joint Compound as supplied by the manufacturer.
            a) Apply the joint compound by brush to ensure coverage.
            b) Care should be taken that the joint compound is smooth without excess buildup in the gasket seat or on the spigot ends.
            c) Coat the gasket seat and spigot ends after the application of the lining.
        4) Surface preparation shall be in accordance with the manufacturer's recommendations.
        5) Check thickness using a magnetic film thickness gauge in accordance with the method outlined in SSPC PA 2.
        6) Test the interior lining of all fittings for pinholes with a non-destructive 2,500 volt test.
            a) Repair any defects prior to shipment.

7) Mark each fitting with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.
8) For all Ductile Iron Fittings in wastewater service where the fitting has been cut, coat the exposed surface with the touch-up material as recommended by the manufacturer.
    a) The touch-up material and the lining shall be of the same manufacturer.

2.01 INSTALLATION

A. General
1. Install fittings, specials and appurtenances as specified herein, as specified in AWWA C600, AWWA M41, and in accordance with the fittings manufacturer's recommendations.
2. Lay fittings to the lines and grades as indicated in the Drawings.
3. Excavate and backfill trenches in accordance with 33 05 10.
4. Embed Ductile Iron Fittings in accordance with 33 05 10.

B. Joint Making
1. Mechanical Joints with required mechanical restraint
    a) All mechanical joints require mechanical restraint.
    b) Bolt the retainer gland into compression against the gasket, with the bolts tightened down evenly then cross torqued in accordance with AWWA C600.
    c) Overstressing of bolts to compensate for poor installation practice will not be permitted.

C. Push-on Joints (restrained)
1. All push-on joints shall be restrained push-on type.
2. Install Push-on joints as defined in AWWA/ANSI C111/A21.11.
3. Wipe clean the gasket seat inside the bell of all extraneous matter.
4. Place the gasket in the bell in the position prescribed by the manufacturer.
5. Apply a thin film of non-toxic vegetable soap lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell.
6. When using a field cut plain end piece of pipe, refinished the field cut and scarf to conform to AWWA M-41.
7. Flanged Joints
    a) Use erection bolts and drift pins to make flanged connections.
        i) Do not use undue force or restraint on the ends of the fittings.
        ii) Apply even and uniform pressure to the gasket.
    b) The fitting must be free to move in any direction while bolting.
        i) Install flange bolts with all bolt heads faced in 1 direction.
8. Joint Deflection
    a) Deflect the pipe only when necessary to avoid obstructions or to meet the lines and grades and shown in the Drawings.
    b) The deflection of each joint must be in accordance with AWWA C600 Table 3.
    c) The maximum deflection allowed is 50 percent of that indicated in AWWA C600.
    d) The manufacturer's recommendation may be used with the approval of the Engineer.

2.02 POLYETHYLENE ENCASEMENT INSTALLATION

A. Preparation

1. Remove all lumps of clay, mud, cinders, etc., on fittings surface prior to installation of polyethylene encasement.
   a) Prevent soil or embedment material from becoming trapped between fittings and polyethylene.
2. Fit polyethylene film to contour of fittings to affect a snug, but not tight encase with minimum space between polyethylene and fittings.
   a) Provide sufficient slack in contouring to prevent stretching polyethylene where it bridges irregular surfaces such as bell-spigot interfaces, bolted joints or fittings, and to prevent damage to polyethylene due to backfilling operations.
   b) Secure overlaps and ends with adhesive tape and hold.
3. For installations below water table and/or in areas subject to tidal actions, seal both ends of polyethylene tube with adhesive tape at joint overlap.
4. Tubular Type (Method A)
   a) Cut polyethylene tube to length approximately 2 feet longer than fittings section.
5. Slip tube around fittings, centering it to provide 1 foot overlap on each adjacent pipe section and bunching it accordion-fashion lengthwise until it clears fittings ends.
   a) Lower fittings into trench with preceding section of pipe.
   b) Make shallow bell hole at joints to facilitate installation of polyethylene tube.
   c) After assembling fittings make overlap of polyethylene tube, pull bunched polyethylene from preceding length of pipe, slip it over end of the fitting and wrap until it overlaps joint at end of preceding length of pipe.
   d) Secure overlap in place.
   e) Take up slack width at top of fitting to make a snug, but not tight, fit along barrel of fitting, securing fold at quarter points.
   f) Repair cuts, tears, punctures or other damage to polyethylene.
   g) Proceed with installation of next fitting in same manner.
6. Tubular Type (Method B)
   a) Cut polyethylene tube to length approximately 1 foot shorter than fitting section.
   b) Slip tube around fitting, centering it to provide 6 inches of bare fitting at each end.
   c) Take up slack width at top of fitting to make a snug, but not tight, fit along barrel of fitting, securing fold at quarter points; secure ends.
   d) Before making up joint, slip 3-foot length of polyethylene tube over end of proceeding pipe section, bunching it accordion-fashion lengthwise.
   e) After completing joint, pull 3-foot length of polyethylene over joint, overlapping polyethylene previously installed on each adjacent section of pipe by at least 1 foot; make each end snug and secure.

B. Sheet Type
1. Cut polyethylene sheet to a length approximately 2 feet longer than piece section.
2. Center length to provide 1-foot overlap on each fitting, bunching it until it clears the fitting ends.
3. Wrap polyethylene around fitting so that it circumferentially overlaps top quadrant of fitting.
4. Secure cut edge of polyethylene sheet at intervals of approximately 3 feet.
5. Lower wrapped fitting into trench with preceding section of pipe.

6. Make shallow bell hole at joints to facilitate installation of polyethylene.
7. After completing joint, make overlap and secure ends.
8. Repair cuts, tears, punctures or other damage to polyethylene.
9. Proceed with installation of fittings in same manner.
10. Pipe-Shaped Appurtenances
    a) Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in same manner as pipe and fittings.
11. Odd-Shaped Appurtenances
    a) When it is not practical to wrap valves, tees, crosses and other odd-shaped pieces in tube, wrap with flat sheet or split length polyethylene tube by passing sheet under appurtenances and bringing it up around body.
    b) Make seams by bringing edges together, folding over twice and taping down.
    c) Tape polyethylene securely in place at the valve stem and at any other penetrations.

C. Repairs

D. Repair any cuts, tears, punctures or damage to polyethylene with adhesive tape or with short length of polyethylene sheet or cut open tube, wrapped around fitting to cover damaged area, and secure in place.
1. Openings in Encasement
2. Provide openings for branches, service taps, blow-offs, air valves and similar appurtenances by making an X-shaped cut in polyethylene and temporarily folding back film.
3. After appurtenance is installed, tape slack securely to appurtenance and repair cut, as well as other damaged area in polyethylene with tape.
4. Service taps may also be made directly through polyethylene, with any resulting damaged areas being repaired as described above.
5. Junctions between Wrapped and Unwrapped Fittings
    a) Where polyethylene-wrapped fitting joins an adjacent pipe that is not wrapped, extend polyethylene wrap to cover adjacent pipe for distance of at least 3 feet.
    b) Secure end with circumferential turns of tape.
    c) Wrap service lines of dissimilar metals with polyethylene or suitable dielectric tape for minimum clear distance of 3 feet away from cast or Ductile Iron Fittings.

E. Blocking
1. Install concrete blocking in accordance with Section 03 30 00 for all bends, tees, crosses and plugs in the pipe lines as indicated in the Drawings.
2. Place the concrete blocking so as to rest against firm undisturbed trench walls, normal to the thrust.
3. The supporting area for each block shall be at least as great as that indicated on the Drawings and shall be sufficient to withstand the thrust, including water hammer, which may develop.
4. Each block shall rest on a firm, undisturbed foundation or trench bottom.
5. If the Contractor encounters soil that appears to be different than that which was used to calculate the blocking according to the Drawings, the Contractor shall notify the Engineer prior to the installation of the blocking.

2.03 REPAIR/RESTORATION

A. Patching
   1. Excessive field-patching is not permitted of lining or coating.
   2. Patching of lining or coating will be allowed where area to be repaired does not exceed 100 square inches and has no dimensions greater than 12 inches.
   3. In general, there shall not be more than 1 patch on either the lining or the coating of any fitting.
   4. Wherever necessary to patch the fitting:
      a) Make patch with cement mortar as previously specified for interior joints.
      b) Do not install patched fitting until the patch has been properly and adequately cured and approved for laying by the Owner.
      c) Promptly remove rejected fittings from the site.

2.04 FIELD QUALITY CONTROL

A. Potable Water Mains
   1. Cleaning, disinfection, hydrostatic testing and bacteriological testing of water mains
      a) Clean, flush, pig, disinfect, hydrostatic test and bacteriological test the water main as specified in Section 33 04 40.

END OF SECTION

SECTION 33 11 12
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Section Includes:

1. Polyvinyl Chloride (PVC) Pressure Pipe 4-inch through 36-inch for potable water, wastewater, and reuse applications

A. Deviations from this City of Fort Worth Standard Specification

1. None.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract
2. Division 1 – General Requirements
3. 33 01 31 – Closed Circuit Television (CCTV) Inspection
4. 33 04 40 – Cleaning and Acceptance Testing of Water Mains
5. 33 05 10 – Utility Trench Excavation, Embedment and Backfill
6. 33 05 24 – Installation of Carrier Pipe in Casing or Tunnel Liner Plate
7. 33 11 11 – Ductile Iron Fittings

PART 2 PRICE AND PAYMENT PROCEDURES

2.01 MEASUREMENT AND PAYMENT:

A. Measurement

1. Measured horizontally along the surface from center line to center line of the fitting, manhole, or appurtenance

B. Payment

2. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid per linear foot of “PVC Water Pipe” installed for:
    1) Various sizes
    2) Various types of backfill
    a. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid per linear foot of “Sewer Force Main” installed for:
        1) Various sizes
3. The price bid shall include:
    a. Furnishing and installing PVC Pressure Pipe with joints as specified by the Drawings
    b. Mobilization
    c. Pavement removal
    d. Excavation
    e. Hauling
    f. Disposal of excess material
    g. Furnishing, placement and compaction of embedment
    h. Furnishing, placement and compaction of backfill
    i. Trench water stops
    j. Thrust restraint, if required by Contract Documents
    k. Gaskets
    l. Clean-up
    m. Cleaning

n. Disinfection
o. Testing

2.02 REFERENCES:

A. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
2. American Association of State Highway and Transportation Officials (AASHTO).
3. ASTM International (ASTM):
   a. D1784, Standard Specification for Rigid Poly(Vinyl-Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   b. D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
4. American Water Works Association (AWWA):
   a. C600, Installation of Ductile-Iron Water Mains and their Appurtenances.
   b. C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipes and Fittings for Water.
   c. C900, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 IN through 12 IN, for Water Transmission and Distribution.
   d. C905, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 14 IN through 48 IN, for Water Transmission and Distribution.
   e. M23, PVC Pipe – Design and Installation.
   f. M41, Ductile-Iron Pipe and Fittings.
5. NSF International (NSF):
   a. 61, Drinking Water System Components – Health Effects.
6. Underwriters Laboratories, Inc. (UL).

2.03 ADMINISTRATIVE REQUIREMENTS [NOT USED]:

2.04 SUBMITTALS:

A. Submittals shall be in accordance with Section 01 33 00.
B. All submittals shall be approved by the City prior to delivery.

2.05 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS:

2.06 PRODUCT DATA:

A. For PVC Pressure Pipe that is used for water distribution, wastewater force mains or wastewater gravity mains, including:
   1. PVC Pressure Pipe
   2. Manufacturer
   3. Dimension Ratio
   4. Joint Types
   5. Restraint, if required in Contract Documents
      a. Retainer glands
      b. Thrust harnesses
      c. Any other means of restraint
B. Gaskets

B. 2.07 SHOP DRAWINGS:

A. When restrained joints are required, furnish for PVC Pressure Pipe used in the water distribution system or for a wastewater force main for 24-inch and greater diameters, including:

C. 1. Wall thickness design calculations sealed by a Licensed Professional Engineer in Texas including:
   a. Working pressure
   b. Surge pressure
   c. Deflection

B. Provide thrust restraint calculations for all fittings and valves, sealed by a Licensed Professional Engineer in Texas, to verify the restraint lengths shown on the Drawings.

C. Lay schedule / drawing for 24-inch and greater diameters sealed by a Licensed Professional Engineer in Texas including:
   1. Pipe class
   2. Joints type
   3. Fittings

D. Stationing
   1. Transitions
   2. Joint deflection

2.07 CERTIFICATES:

A. Furnish an affidavit certifying that all PVC Pressure Pipe meets the provisions of this Section, each run of pipe furnished has met Specifications, all inspections have been made and that all tests have been performed in accordance with AWWA C900 or AWWA C905.

2.08 CLOSEOUT SUBMITTALS [NOT USED]

2.09 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

2.10 QUALITY ASSURANCE:

A. Qualifications
   1. Manufacturers
      a) Finished pipe shall be the product of 1 manufacturer for each size, unless otherwise approved by the City.
         i) Change orders, specials, and field changes may be provided by a different manufacturer upon City approval.
      b) Pipe manufacturing operations shall be performed under the control of the manufacturer.
      c) All pipe furnished shall be in conformance with AWWA C900 and AWWA C905.

2.11 DELIVERY, STORAGE, AND HANDLING:

A. Storage and Handling Requirements
   1. Store and handle in accordance with the guidelines as stated in AWWA M23.
   2. Secure and maintain a location to store the material in accordance with Section 01 66 00.

2.12 FIELD [SITE] CONDITIONS [NOT USED]

2.13 WARRANTY [NOT USED]

PART 3 PRODUCTS

2.14 OWNER-FURNISHED [OR] OWNER-SUPPLIED PRODUCTS [NOT USED]

2.15 EQUIPMENT, PRODUCT TYPES AND MATERIALS:

A. Manufacturers
   1. Only the manufacturers as listed in the City's Standard Products List will be considered as shown in Section 01 60 00.
      a) The manufacturer must comply with this Specification and related Sections.
   2. Any product that is not listed on the Standard Products List is considered a substitution and shall be submitted in accordance with Section 01 25 00.

B. Pipe
   1. Pipe shall be in accordance with AWWA C900 or AWWA C905.
   2. PVC Pressure Pipe for potable water shall meet the requirements of NSF 61.
   3. Pressure Pipe shall be approved by the UL.
   4. Pipe shall have a lay length of 20 feet except for special fittings or closure pieces necessary to comply with the Drawings.
   5. The pipe material shall be PVC, meeting the requirements of ASTM D1784, with a cell classification of 12454. Outside diameters must be equal to those of cast iron and ductile iron pipes.
   6. As a minimum the following Dimension Ratio's apply:

Diameter (inch)	Min Pressure Class (psi)
4 through 12	DR 14
16 through 24	DR 18

   7. Pipe Markings
      a) Meet the minimum requirements of AWWA C900 or AWWA C905. Minimum pipe markings shall be as follows:
         i) Manufacturer's Name or Trademark and production record
         ii) Nominal pipe size
         iii) Dimension Ratio
         iv) AWWA C900 or AWWA C905
         v) Seal of testing agency that verified the suitability of the pipe

C. Pressure and Deflection Design
   1. Pipe design shall be based on trench conditions and design pressure class specified in the Drawings. Pipe shall be designed according to the methods indicated in AWWA M23 for trench construction, using the following parameters:
      a) Unit Weight of Fill (w) = 130 pcf
      b) Live Load = AASHTO HS 20
      c) Trench Depth = 12 feet minimum, or as indicated in Drawings
      d) Maximum E' = 1,000 max
      e) Deflection Lag Factor = 1.0
      f) Working Pressure (P_w) = 150 psi
      g) Surge Allowance (P_s) = 100 psi minimum
      h) Test Pressure =
         i) No less than 1.25 times the stated working pressure (187 psi minimum) of the pipeline measured at the highest elevation along the test section.

ii) No less than 1.5 times the stated working pressure (225 psi minimum) at the lowest elevation of the test section.

i) Maximum Calculated Deflection = 3 percent

j) Restrained Joint Safety Factor (SF) = 1.5

k) Maximum Joint Deflection = 50 percent of the manufacturer's recommendations.

2. Verify trench depths after existing utilities are located.
   a) Accommodate vertical alignment changes required because of existing utility or other conflicts by an appropriate change in pipe design depth.
   b) In no case shall pipe be installed deeper than its design allows.
3. Provisions for Thrust
   a) Thrusts at bends, tees, plugs or other fittings shall be mechanically restrained joints when required by the Drawings.
   b) No thrust restraint contribution shall be allowed for the restrained length of pipe within the casing.
   c) Restrained joints, where required, shall be used for a sufficient distance from each side of the bend, tee, plug, valve, or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purpose of thrust the following shall apply:
      i) Calculate valves as dead ends.
      ii) Design pressure shall be greater than the pressure class of the pipe or the internal pressure (P_i), whichever is greater.
      iii) Restrained joints shall consist of approved mechanical restrained or push-on restrained joints as listed in the City's Standard Products List as shown in Section 01 60 00.
      iv) Restrained PVC pipe is not allowed for pipe greater than 12 inches.
   d) The Pipe Manufacturer shall verify the length of pipe with restrained joints to resist thrust in accordance with the Drawings and the following:
      i) Calculate the weight of the earth (W_e) as the weight of the projected soil prism above the pipe, for unsaturated soil conditions.
      ii) Soil density = 115 pcf (maximum value to be used), for unsaturated soil conditions
      iii) In locations where ground water is encountered, reduce the soil density to its buoyant weight for the backfill below the water table.
         1. Reduce the coefficient of friction to 0.25.
4. Joints
   a) Joints shall be gasket, bell and spigot and push-on type conforming to ASTM D3139.
   b) Since each pipe manufacturer has a different design for push-on joints, gaskets shall be part of a complete pipe section and purchased as such.
   c) Lubricant must be non-toxic and NSF approved for potable water applications.
   d) Push-On Restrained Joints shall only be as approved in the Standard Products List in Section 01 60 00.
5. Detectable Markers
   a) Provide detectable markers in accordance with Section 33 05 26.

2.16 ACCESSORIES [NOT USED]

2.17 SOURCE QUALITY CONTROL [NOT USED]

PART 4 EXECUTION

2.18 INSTALLERS [NOT USED]

2.19 EXAMINATION [NOT USED]

2.20 PREPARATION [NOT USED]

2.21 INSTALLATION:

A. General
   1. Install pipe, fittings, specials and appurtenances as specified herein, as specified in AWWA C600, AWWA C605, AWWA M23 and in accordance with the pipe manufacturer's recommendations.
   2. Lay pipe to the lines and grades as indicated in the Drawings.
   3. Excavate and backfill trenches in accordance with Section 33 05 10.
   4. Embed PVC Pressure Pipe in accordance with Section 33 05 10.
   5. For installation of carrier pipe within casing, see Section 33 05 24.

B. Pipe Handling
   1. Haul and distribute pipe and fittings at the project site.
   2. Handle piping with care to avoid damage.
      a) Inspect each joint of pipe and reject or repair any damaged pipe prior to lowering into the trench.
      b) Use only nylon ropes, slings or other lifting devices that will not damage the surface of the pipe for handling the pipe.
   3. At the close of each operating day:
      a. Keep the pipe clean and free of debris, dirt, animals and trash – during and after the laying operation.
      b. Effectively seal the open end of the pipe using a gasketed night cap.

C. Joint Making
   1. Mechanical Joints
      a) In accordance with Section 33 11 11.
   2. Push-on Joints
      a) Install Push-On joints as defined in AWWA C900 and AWWA C905.
      b) Wipe clean the gasket seat inside the bell of all extraneous matter.
      c) Place the gasket in the bell in the position prescribed by the manufacturer.
      d) Apply a thin film of non-toxic vegetable soap lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell.
      e) When using a field cut plain end piece of pipe, refinish the field cut to conform to AWWA C605.
   3. Joint Deflection
      a) Deflect the pipe only when necessary to avoid obstructions, or to meet the lines and grades shown in the Drawings.

D. Joint deflection shall not exceed 50 percent of the manufacturer's recommendation.

E. Detectable Metallic Tape Installation
   1. See Section 33 05 26.

2.22 REPAIR/RESTORATION [NOT USED]

2.23 RE-INSTALLATION [NOT USED]

2.24 FIELD [OR] SITE QUALITY CONTROL:

A. Potable Water Mains

1. Cleaning, disinfection, hydrostatic testing, and bacteriological testing of water mains:
    a) Clean, flush, pig, disinfect, hydrostatic test and bacteriological test the water main as specified in Section 33 04 40.

B. Wastewater Lines
1. Closed Circuit Television (CCTV) Inspection
    a) Provide a Post-CCTV Inspection in accordance with Section 33 01 31.

END OF SECTION

SECTION 33 14 19

DRY-BARREL FIRE HYDRANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dry-barrel fire hydrants with $5^1/_4$-inch main valve for use with potable water mains

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 0 – Bidding Requirements, Contract Forms and Conditions of the Contract
2. Division 1 – General Requirements
3. Section 33 01 13 – Cleaning and Approval
4. Section 33 05 06 – Pipe Bedding and Backfill Material
5. Section 33 05 19 – Ductile Iron Pipe and Fittings
6. Section 33 05 24 – Steel Pipe and Fittings
7. Section 33 05 84 – Gate Valves

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement
    a. Fire Hydrant and Extension
        1) Measurement for this item shall be by the each hydrant, complete in place.
2. Payment
    a. The Work performed and materials furnished in accordance with this Item and measured under “Measurement” will be paid for at the unit prices bid per each “Fire Hydrant” installed.
3. The price bid shall include:
    a. Furnishing and installing Fire Hydrants with appurtenances as specified in the Drawings
    b. Dry-Barrel Fire Hydrant assembly from base to operating nut

c. Extension barrel and stem

d. Adjusting hydrant to the appropriate height

e. Painting

f. Pavement Removal

g. Excavation

h. Freight, loading, unloading and handling

i. Disposal of excess material

j. Furnish, placement and compaction of embedment

k. Furnish, placement and compaction of backfill

l. Blocking, Braces and Rest

m. Clean up

n. Disinfection

o. Testing

1.3 REFERENCES

A. Definitions

1. Base: The lateral connection to the fire hydrant lead; also called a shoe

B. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.

2. American Water Works Association (AWWA):

a. C502, Dry-Barrel Fire Hydrants

b. Manual of Water Supply Practices M17 (AWWA Manual M17) – Installation, Field Testing, and Maintenance of Fire Hydrants

3. NSF International

a. 61, Drinking Water System Components – Health Effects

b. 372, Drinking Water System Components – Lead Content

4. National Fire Protection Association (NFPA)

a. 1963, Standard for Fire Hose Connections

5. Underwriters Laboratories, Inc. (UL)

a. 246, Hydrants for Fire-Protection Service

6. Factory Mutual (FM)

a. Class Number 1510, Approval Standard for Fire Hydrant (Dry Barrel Type) for Private Fire Service

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to construction.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data

1. Dry-Barrel Fire Hydrant stating:

a. Main valve opening size

b. Nozzle arrangement and sizes

c. Operating nut size

d. Operating nut operating direction

e. Working pressure rating

f. Component assembly and materials

g. Coatings and Finishes

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE

A. Qualifications

1. Manufacturers

a. Dry-Barrel Fire Hydrants shall be the product of 1 manufacturer.

1) Change orders, specials and field changes may be provided by a different manufacturer upon City approval.

2. Dry-Barrel Fire Hydrants shall be in conformance with AWWA C502, UL 246 and FM 1510.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements

1. Store and handle in accordance with the guidelines as stated in AWWA C502 and AWWA Manual M17.

2. Protect all parts so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

3. Protect all equipment and parts against any damage during a prolonged period at the site.

4. Protect the finished surfaces of all exposed flanges by wooden blank flanges, strongly built and securely bolted thereto.

5. Protect finished iron or steel surfaces not painted to prevent rust and corrosion.

6. Prevent plastic and similar brittle items from being directly exposed to sunlight or extremes in temperature.

7. Secure and maintain a location to store the material in accordance with Section 01 66 00.

1.11 FIELD CONDITIONS [NOT USED]

1.12 WARRANTY

A. Manufacturer Warranty

1. Manufacturer's Warranty shall be in accordance with Division 1.

PART 2 - PRODUCTS

2.1 CITY-FURNISHED [OR] CITY-SUPPLIED PRODUCTS [NOT USED]

2.2 EQUIPMENT, PRODUCT TYPES, AND MATERIALS

A. Manufacturers

1. Only the manufacturers as listed on the City's Standard Products List will be considered as shown in Section 01 60 00.

a. The manufacturer must comply with this Specification and related Sections.

2. Any product that is not listed on the Standard Products List is considered a substitution and shall be submitted in accordance with Section 01 25 00.

3. The Dry-Barrel Fire Hydrant shall be new and the product of a manufacturer regularly engaged in the manufacturing of Dry-Barrel Fire Hydrants having similar service and size.

B. Description

1. Regulatory Requirements

a. Dry-Barrel Fire Hydrant shall meet or exceed the latest revisions of AWWA C502 and shall meet or exceed the requirements of this Specification.

b. All Dry-Barrel Fire Hydrant components in contact with potable water shall conform to the requirements of NSF 61.

C. Performance / Design Criteria

1. Capacities

a. Rated working pressure of 250 psi or greater

2. Design Criteria

a. Operating nut

1) Non-rising, pentagonal shape nut measuring:

a) 1-1/2”from point of opposite flat

b) 1-1/4” depth for pentagon

2) Open by turning the operating nut to the left (**counterclockwise**)

a) Provide operating direction clearly marked with an embossed arrow.

3) Provide a weather cap which conceals the hold down nut.

b. Main Valve

1) Composition

a) Minimum 5-1/4” in diameter

b) Not less than 1” thick

c) Rubber or neoprene

2) Durometer hardness of 90 + 5Compression type

a) Opening against pressure

b) Closing with pressure

c. Nozzles

1) 3 way arrangement

a) Nozzles shall thread counter-clockwise into barrel with “O” ring pressure seals

2) Nozzle sizes

a) Hose nozzles

(1) Two 2-1/2”hose nozzles

(a) 180 degrees apart

(b) Right hand National Standard Thread

b) Pump nozzle

(1) 5” Storz quick connection pumper nozzle

(a) Storz connection shall have matching cap with cable tether

(b) Storz shall be free of louvers

d. Hydrant Barrel Configuration

1) Upper barrel

a) Shall be fabricated of cast iron.

2) Breakable swivel flange

a) To join the upper and lower barrels approximately 2” above the final grade line

b) Shall have a minimum of eight bolts

c) Shall provide 360 degree rotation of upper barrel

3) Pressure seal

a) Shall be cloth impregnated rubber gasket

b) An “O” ring is not acceptable.

4) Breakable stem

a) Shall join the two-piece stem adjacent to the ground-line flange

b) Screws, pins, fasteners or bolts used in the coupling shall be stainless steel

c) Weakened portion of stem coupling shall be below the coupling pins.

5) Lower barrel

a) Shall be fabricated of cast iron.

b) The ground line shall not be less than eighteen inches below the centerline of the lowest nozzle.

c) The ground line shall be clearly embossed on the lower barrel.

e. Lubrication reservoir

1) Shall be filled with a viscous, non-toxic lubricant

2) Shall be sealed at the top and bottom with “O” rings.

3) Design

a) The bearing surfaces and threaded parts are automatically lubricated when hydrant is operated.

b) No less then two “O” rings separating the waterway from the oil reservoir and that portion of the stem making this seal shall be sleeved with bronze.

c) An anti-friction washer shall be in place above the thrust collar to minimize operation torque.

f. Bonnet

1) Shall be attached to the upper barrel by not less than eight bolt utilizing a cloth impregnated rubber gasket as a pressure seal.

g. Drain Valve

1) Shall operate without springs, tubes, levers, toggles, or other intricate mechanism

2) A gravel bed around the weep holes is required.

h. Shoe connection

1) Shall be a 6” approved mechanically restrained joint.

2) Shall have ample blocking pads for sturdy setting and concrete blocking.

3) A minimum of 6 bolts is required to fasten the shoe to the lower barrel.

4) Interior, lower valve plate, and cap nut

a) Shall have a protective epoxy coating of at least 4 mils.

b) If cap nut is utilized, it must be locked in place with a stainless steel lock washer or similar non-corrosive device.

D. Function

1. Drain Valve

a. Drain fire hydrant barrels when main valve is closed. Seal shut when open.

E. Materials

1. Furnish materials in accordance with AWWA C502.
2. Dry-Barrel Fire Hydrant Assembly
    a. Internal parts
        1) Threads
            a) Provide operating thread designed to avoid metal such as iron or steel threads against iron or steel parts.
        2) Stem
            a) Stem Nuts
                (1) Provide bronze stem nuts.
                    (a) Grades per AWWA C502
            b) Where needed, stem shall be grooved and sealed with O-rings.
        3) Upper valve plate and seat ring
            a) Shall be bronze.
            b) Shall Work in conjunction to form an all-bronze drain-way.
            c) Drain holes drilled in the shoe must be bronze lined.
            d) Seat rings seals shall be “O” ring type.
            e) Zinc content of bronze parts shall not exceed 16%.
        4) Drain ring
            a) Two drain openings are required.
            b) The bronze seat ring must thread into a bronze drain ring or shoe bushing providing a bronze to bronze connection.
3. Provide crushed rock for placement around base conforming to Section 33 05 06.

F. Finishes
1. Primer Materials
    a. Furnish primer for Dry-Barrel Fire Hydrants in accordance with AWWA C502.
2. Finish Materials
    a. Dry-Barrel Fire Hydrant
        1) Exterior

a) Above grade

(1) Furnish exterior coating for above grade Dry-Barrel Fire Hydrant assembly components with an approved rust inhibiting paint and in accordance with AWWA C502.

(2) Body parts, bonnet, and caps shall be in the color Carmine Red.

(3) Dead end flushing hydrants should be blue in color.

b) Below grade

(1) Furnish exterior coating for below grade Dry-Barrel Fire Hydrant assembly components in accordance with AWWA C502.

2) Interior

a) Interior coating for Dry-Barrel Fire Hydrants assemblies in accordance with AWWA C502

2.3 ACCESSORIES

A. Polyethylene Encasement

1. Provide polyethylene encasement.

B. Embedment

1. Provide crushed rock and filter fabric in accordance with Section 33 05 06.

2.4 SOURCE QUALITY CONTROL

A. Tests and Inspections

1. Testing and inspection of Dry-Barrel Fire Hydrants in accordance with AWWA C502.

B. Markings

1. Provide each Dry-Barrel Fire Hydrant marked in accordance with AWWA C502.

PART 3 - EXECUTION [NOT USED]

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION [NOT USED]

3.4 INSTALLATION

A. General

1. Install in accordance with AWWA Manual of Water Supply Practice M17, manufacturer's recommendations and as shown on the Drawings.
2. Provide vertical installation with braces, rest and blocking in accordance with City Standard Details.
3. Excavate and backfill trenches in accordance with 33 05 06.
4. Embed Dry-Barrel Fire Hydrant assemblies in accordance with 33 05 06.
    a. At the location of the weep holes, wrap barrel with polyethylene encasement and crushed rock with filter fabric to prevent dirt and debris from entering the fire hydrant.
5. Polyethylene encasement installation shall be in accordance with the applicable portion of Section 33 11 10.
6. Install concrete blocking and rest in accordance with Section 03 30 00 as indicated in the Drawings.
7. A minimum 3 cubic feet of crushed rock shall be placed around the base, in accordance with AWWA Manual of Water Supply Practice M17, to allow drain outlets to operate.
    a. The crushed rock should extend 6 inches above the drain outlets and a minimum of 1 foot on all sides of the fire hydrant base.
8. Fire hydrant lead line shall be installed with a maximum cover of 7 feet.
    a. Cover is measured from the invert at the fire hydrant base, vertical to ground elevation.
    b. Fittings may be used along fire lead line to ensure minimum and maximum cover requirements are met.
9. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb or future curb.
10. They shall be installed with the hydrant bury mark approximately 6" above level with the finish grade.
11. The contoured shoe of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust blocking (taking care not to obstruct the hydrant drain holes) and each hydrant cradled with a minimum of 6" of concrete placed under the shoe.
12. A drainage pit 2 feet in diameter and 2 feet in depth, located about the drain ring housing, shall be filled with coarse gravel.

3.5 REPAIR / RESTORATION [NOT USED]

3.6 RE-INSTALLATION [NOT USED]

3.7 FIELD CONTROL

A. Field Inspections

1. The Dry-Barrel Fire Hydrant and assembly shall perform as intended with no deformation, leaking or damage of any kind for the pressure ranges indicated.

2. City inspector will issue final inspection notice to City staff.

3. City Field Operations Staff and Fire Department Staff shall have the opportunity to inspect and operate the hydrant, to ensure that the fire hydrant was installed in accordance with AWWA Manual of Water Supply Practice M17. This includes but is not limited to:

   a. Operation of Nozzles and operating nut are not obstructed.

   b. Drain valve is not obstructed or plugged

4. Keep fire hydrant wrapped or covered to identify that it is out of service until the water line it's connected to is put in service.

B. Non-Conforming Work

1. If access and operation of the Dry-Barrel Fire Hydrant or its appurtenances do not meet the criteria of the AWWA Manual of Water Supply Practice M17, the Contractor will remedy the situation criteria, at the Contractor's expense.

3.8 SYSTEM STARTUP [NOT USED]

3.9 ADJUSTING [NOT USED]

3.10 CLEANING [NOT USED]

3.11 CLOSEOUT ACTIVITIES [NOT USED]

3.12 PROTECTION [NOT USED]

3.13 MAINTENANCE [NOT USED]

3.14 ATTACHMENTS [NOT USED]

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 33 14 25

CONNECTIONS TO EXISTING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Connection to existing water mains to include, but not limited to:
   a. Cutting in a tee for a branch connection
   b. Extending from an existing water main
   c. Installing a tapping sleeve and valve

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 0 – Bidding Requirements, Contract Forms, and Conditions of the Contract
2. Division 1 – General Requirements
3. Section 33 01 13 – Cleaning and Approval
4. Section 33 05 06 – Pipe Bedding and Backfill Material
5. Section 33 05 19 – Ductile Iron Pipe and Fittings
6. Section 33 05 22 – Nuts, Bolts, and Gaskets

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Connection to an existing unpressurized Water Distribution System Main that does not require the City to take part of the water system out of service
   a. Measurement
      1) This Item is considered subsidiary to the water pipe being installed.
   b. Payment
      1) The Work performed and the materials furnished in accordance with this Item are subsidiary to the unit price bid per linear foot of water pipe complete in place, and no other compensation will be allowed.
2. Connection to an existing pressurized Water Distribution System Main that requires a shutdown of some part of the water system
   a. Measurement
      1) Measurement for this Item shall be per each connection completed.
   b. Payment
      1) The Work performed and the materials furnished in accordance with this Item shall be paid for at the unit price bid per each “Connection to Existing Water Main” installed for:
         a) Various sizes of existing water distribution main
   c. The price bid shall include all aspects of making the connection including, but not limited to:
      1) Preparing submittals
      2) Dewatering
      3) Exploratory excavation (as needed)

4) Coordination and notification
5) Remobilization
6) Temporary lighting
7) Polyethylene encasement
8) Make-up pieces
9) Linings
10) Pavement removal
11) Excavation
12) Hauling
13) Disposal of excess material
14) Clean-up
15) Cleaning
16) Disinfection
17) Testing

3. Connection to an existing pressurized Water Distribution System Main by Tapping Sleeve and Valve:
   a. Measurement
      1) Measurement for this Item shall be per each connection completed.
   b. Payment
      1) The Work performed and the materials furnished in accordance with this Item shall be paid for at the unit price bid per each "Tapping Sleeve and Valve" installed for:
         a) Various sizes of connecting main
         b) Various sizes of existing water distribution main
   c. The price bid shall include all aspects of making the connection including, but not limited to:
      1) Preparing submittals
      2) Dewatering
      3) Exploratory excavation (as needed)
      4) Coordination and notification
      5) Tapping Sleeve and Tapping Valve
      6) Remobilization
      7) Temporary lighting
      8) Polyethylene encasement
      9) Make-up pieces
      10) Linings
      11) Pavement removal
      12) Excavation
      13) Hauling
      14) Disposal of excess material
      15) Clean-up
      16) Cleaning
      17) Disinfection
      18) Testing

1.3 REFERENCES

A. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
2. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250)
3. ASTM International (ASTM):
   a. A36, Standard Specification for Carbon Structural Steel.
   b. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
   c. A194, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
   d. A242, Standard Specification for High-Strength Low-Alloy Structural Steel.
   e. A283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   f. A285, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength.
   g. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
   h. D2000, Standard Classification System for Rubber Products in Automotive Applications.
4. American Water Works Association (AWWA):
   a. C200, Steel Water Pipe - 6 IN and Larger.
   b. C207, Steel Pipe Flanges for Waterworks Service – Sizes 4 IN through 144 IN.
   c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   d. C223, Fabricated Steel and Stainless Steel Tapping Sleeves.
5. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   b. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   c. C115A21/15, Flanged Ductile-Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges.
6. NSF International (NSF):
   a. 61, Drinking Water System Components – Health Effects.
7. Manufacturers Standardization Society of the Valve and Fitting Industry Inc. (MSS):
   a. SP-60, Connecting flange Joint Between Tapping Sleeves and Tapping Valves.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings

1. Required for any connections to an existing, pressurized 16-inch or larger City water distribution system main that requires a shutdown of some part of the water system
2. May also be required for connections that involve shutting water service off to certain critical businesses
3. Schedule a pre-installation meeting a minimum of 3 weeks prior to proposed time for the Work to occur.
4. The meeting shall include the Contractor, City Inspector and City Valve Crew.
5. Review Work procedures as submitted and any adjustments made for current field conditions.
6. Verify that all valves and plugs to be used have adequate thrust restraint or blocking.

7. Schedule a test shutdown with the City.
8. Schedule the date for the connection to the existing system.

B. Scheduling

1. Schedule Work to make all connections to existing 16-inch and larger mains:
   a. During the period from November through April, unless otherwise approved by the City
   b. During normal business hours from Monday through Friday, unless otherwise approved by the City
2. Schedule City Valve Crew by 1:00 P.M. a minimum of 2 business days prior to planned disruption to the existing water system.
   a. In the event that other water system activities do not allow the existing main to be dewatered at the requested time, schedule Work to allow the connection at an alternate time acceptable to the City.
      1) If water main cannot be taken out of service at the originally requested time, coordination will be required with the City to discuss rescheduling and compensation for mobilization.
      2) No additional payment will be provided if the schedule was altered at the Contractor's request.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery and/or fabrication for specials.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data, if applicable

1. Tapping Sleeve noting the pressure rating and coating system supplied including:
   a. Dimensions, weights, material list, and detailed drawings
   b. Maximum torque recommended by the manufacturer for the valve by size

B. Submittals

1. Provide a detailed sequence of Work for 12-inch or larger connections if required by City that includes:
   a. Results of exploratory excavation
   b. Dewatering
   c. Procedure for connecting to the existing water main
   d. Time period for completing Work from when the water is shut down to when the main is back in service
   e. Testing and repressurization procedures
2. Welders that are assigned to work on connection to concrete cylinder or steel pipe must be certified and provide Welding Certificates, upon request, in accordance with AWWA C200.

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements

1. Protect parts so that no damage or deterioration occurs during a prolonged delay from the time of shipment until installation is completed.
2. Protect all equipment and parts against any damage during a prolonged period at the site.
3. Protect the finished surfaces of all exposed flanges using wooden flanges, strongly built and securely bolted thereto.
4. Protect finished iron or steel surfaces not painted to prevent rust and corrosion.
5. Prevent plastic and similar brittle items from being exposed to direct sunlight and extremes in temperature.
6. Secure and maintain a location to store the material in accordance with Section 01 66 00.

1.11 FIELD [SITE] CONDITIONS [NOT USED]

1.12 WARRANTY

A. Manufacturer Warranty

1. Manufacturer's warranty shall be in accordance with Division 1.

PART 2 - PRODUCTS

2.1 CITY-FURNISHED [OR] CITY-SUPPLIED PRODUCTS [NOT USED]

2.2 EQUIPMENT, PRODUCT TYPES AND MATERIALS

A. Manufacturers

1. Only the manufacturers as listed by the City's Standard Products List will be considered as shown in Section 01 60 00.
   a. The manufacturer must comply with this Specification and related Sections.
2. Any product that is not listed on the Standard Products List is considered a substitution and shall be submitted in accordance with Section 01 25 00.

B. Description

1. Regulatory Requirements
   a. Tapping Sleeves shall meet or exceed AWWA C223 and the requirements of this Specification.
   b. All valve components in contact with potable water shall conform to the requirements of NSF 61.

C. Tapping Sleeve Materials

1. Body

a. Full-body mechanical joint cast iron tapping sleeves shall be used for four-inch and larger connections to an existing water line.
b. Finish: fusion bonded epoxy coating to an average 12 mil thickness. Fusion applied per AWWA C213.
c. All buried tapping sleeves shall be provided with polyethylene encasement in accordance with AWWA/ANSI C105/A21.5.

2. Flange
   a. Carbon Steel per ASTM A36 in accordance with AWWA C207 and ASME B16.1 Class 125.
   b. Recessed for tapping valve per MSS SP-60
3. Bolts and Nuts
   a. Flanged Ends
      1) Outlet flange shall conform to class 125 ANSI B 16.1.
      2) Provide bolts and nuts in accordance with Section 33 05 22.
4. Gaskets
   a. Provide gaskets in accordance with Section 33 05 22.
5. Test Plug
   a. ¾-inch NPT carbon steel with square head and fusion bonded epoxy coating

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION

A. Verification of Conditions

1. Verify by exploratory excavation, if needed, that existing water main is as depicted in the Drawings and that the location is suitable for a connection to the existing water main.
   a. Excavate and backfill trench for the exploratory excavation in accordance with 33 05 06.
2. Verify that all equipment and materials are available on–site prior to the shutdown of the existing main.
3. Pipe lines shall be completed, tested and authorized for connection to the existing system in accordance with Section 33 01 13.

3.3 PREPARATION [NOT USED]

3.4 INSTALLATION

A. General

1. Connections to an existing system shall be accomplished without interrupting normal service, wherever possible.
2. Upon disruption of the existing water main, continue Work until the connection is complete and the existing water main is back in service.
   a. The contractor shall be responsible for the advance notification to individuals affected by the interruption of service.

b. Notifications must be written and include the date, time and the proposed duration of interrupted service.

3. In-line installations and extensions that require the operation of valves within the serviced system shall be scheduled in advance and must be approved by the Public Work Department.
   a. City personnel will make all shut-outs on existing mains.
4. Unless otherwise approved, connections to an existing system shall be pressure tapped.
   a. A pressure tap shall consist of connecting new piping to the existing water system by drilling into the existing pipe while it is carrying water under normal pressure, without taking the existing piping out of service.
   b. The contractor shall perform all excavation, furnish and install tapping sleeve, valves and accessories in conformance with these specifications and provide the tapping machine and drill the tap and shall block, cradle and backfill the piping, valve and all accessories.
5. All service connections shall be constructed in accordance with "Standards Details," and all service connections shall be inspected prior to any cover up by a representative from the City's Line Repair Department.

B. Procedure

1. Expose the proposed connection point.
2. Dewater the existing water line so the chlorinated water is not unlawfully discharged.
3. Maintain the water that may bleed by existing valves or plugs during installation within the Work area to a reasonable level.
   a. Control the water in such a way that it does not interfere with the proper installation of the connection or create a discharge of chlorinated water.
4. If any discharge of chlorinated water occurs, discharged water shall be de-chlorinated in accordance with Section 33 01 13
5. Cut and remove existing water main in order to make the connection.
6. Verify that the existing pipe line is suitable for the proposed connection.
7. Place trench foundation and bedding in accordance with 33 05 06.
8. In the event that a tapping sleeve and valve is used, the coupon from the existing water main shall be submitted to the City.
9. Prevent embedment, backfill, soil, water or other debris form entering the pipeline.
10. Establish thrust restraint as provided for in the Drawings.
11. Clean and disinfect the pipeline associated with the connection in accordance with Section 33 01 13.
12. Place embedment to the top of the pipe zone.
13. Request that the City Valve Crew re-pressurize the pipeline.
14. Directionally flush the connection in accordance with Section 33 01 13.
15. Request that City Valve Crew open all remaining valves.

END OF SECTION

SECTION 33 31 16

SANITARY SEWER SERVICE CONNECTIONS AND SERVICE LINE

PART 1 - GENERAL

1.1 SUMMARY

A. Sanitary sewer service connections, service line, and cleanout appurtenances for:
   1. New Service.
   2. New Bored Service.
   3. New Service (City performed).
   4. Private Service Relocations.
   5. Service Reinstatement.
   6. Sanitary Sewer Mainline Cleanout.

B. Related Specification Sections include but are not limited to
   1. Division 0 – Bidding Requirements, Contract Forms and Conditions of the Contract.
   2. Division 1 – General Requirements.
   3. Section 33 05 06 – Utility Trench Excavation, Embedment and Backfill.
   4. Section 33 05 19 – Ductile Iron Pipe and Fittings.
   5. Section 33 05 31 – Polyvinyl Chloride (PVC) Pressure Pipe.
   6. Section 33 05 38 – High Density Polyethylene (HDPE) Pipe.
   7. Section 33 05 32 – Polyvinyl Chloride (PVC) Gravity Sanitary Sewer Pipe.

1.2 PRICE AND PAYMENT PROCEDURES

1. New Sewer Service
   a. Measurement
      1) Measurement for this Item shall be per each “Sewer Service” complete in place.
   b. Payment
      1) The Work performed and materials furnished in accordance with this Item will be paid for at the unit price bid per each “Sewer Service” installed for:
         a) Various sizes.
         b) Various materials.
   c. The price bid shall include:
      1) Furnishing and installing New Sanitary Sewer Service Line as specified by the Drawings
      2) Service line installed by open cut
      3) Temporary lighting
      4) Traffic Control associated with connection
      5) Pavement removal
      6) Plating of open trenches
      7) Excavation
      8) Hauling

9) Disposal of excess material
10) Wye connection to main
11) Fittings
12) Cleanout and cap with box
13) Surface restoration
14) Furnishing, placement, and compaction of embedment
15) Furnishing, placement, and compaction of backfill
16) Concrete encasement for deep services
17) Clean-up

2. New Bored Sewer Service
   a. Measurement
      1) Measurement for this Item shall be per each "Bored Sewer Service" complete in place.
   b. Payment
      1) The Work performed and materials furnished in accordance with this Item will be paid for at the unit price bid per each "Sewer Service" installed for:
         a) Various sizes.
         b) Various materials.
   c. The price bid shall include:
      1) Furnishing and installing New Sanitary Sewer Service Line as specified by the Drawings
      2) Service line installed by directional drilling
      3) Temporary lighting
      4) Traffic Control associated with connection
      5) Pavement removal
      6) Plating of open trenches
      7) Excavation
      8) Hauling
      9) Disposal of excess material
      10) Wye connection to main
      11) Fittings
      12) Cleanout and cap with box
      13) Surface restoration
      14) Furnishing, placement, and compaction of embedment
      15) Furnishing, placement, and compaction of backfill
      16) Concrete encasement for deep services
      17) Clean-up

3. Private Service Relocation
   a. Measurement
      1) Measured horizontally along the surface from center line to center line of the fitting, manhole, or appurtenance.
   b. Payment
      1) The Work performed and the materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid per linear foot for "Private Sewer Service" installed for:
         a) Various sizes.

b) Various materials.

c. The price shall include:
   1) Obtaining required Permit(s)
   2) Obtaining Right of Entry
   3) Performing relocation as specified in the Drawings
   4) Excavation
   5) Hauling
   6) Disposal of excess material
   7) Service Line - private side by plumber
   8) Fittings
   9) Furnishing, placement, and compaction of embedment
   10) Furnishing, placement, and compaction of backfill
   11) Clean-up
   12) Surface restoration

4. Sanitary Sewer Mainline Cleanout
   a. Measurement
      1) Measurement for this item shall be per each "Sanitary Sewer Mainline Cleanout" complete in place.
   b. Payment
      1) The Work performed and materials furnished in accordance with this item will be paid for at the unit price bid per each "Sanitary Sewer Mainline Cleanout" installed for:
         a) Various sizes.
         b) Various materials.
   c. The price bid shall include:
      1) Furnishing and installing Sanitary Sewer Mainline Cleanout as specified by the Drawings
      2) Temporary lighting
      3) Traffic Control associated with connection
      4) Pavement removal
      5) Plating of open trenches
      6) Excavation
      7) Hauling
      8) Disposal of excess material
      9) Wye connection to main
      10) Fittings
      11) Cleanout and cap with box
      12) Surface restoration
      13) Furnishing, placement, and compaction of embedment
      14) Furnishing, placement, and compaction of backfill
      15) Concrete encasement
      16) Clean-up

1.3 REFERENCES

A. Reference Standards

1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section, unless a date is specifically cited.
2. ASTM International (ASTM):
    a. ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
    b. ASTM C1173, Standard Specification for Flexible Transition Couplings for Underground Piping Systems.
    c. ASTM D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
    d. ASTM D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Scheduling
    1. Provide advance notice for service interruption to property owner in accordance with Section 01 35 13.
    2. Service interruptions may only occur during normal business hours from Monday through Friday, unless otherwise approved by the City.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product data shall include, if applicable:
    1. Wye connection or saddle
    2. Fittings (including type of cleanout)
    3. Service line

B. Certificates
    1. Furnish an affidavit certifying service line and fittings are in accordance with this Section.

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements
    1. Pipe manufactured more than 2 years prior to installation date will not be accepted by the City.

B. Storage and Handling Requirements

1. Pipe and other material shall be stored and handled in accordance with the manufacturer's guidelines.
2. Protect pipe from UV exposure.
   a. When long-term storage (more than 2-months) with exposure to direct sunlight is unavoidable, cover PVC pipe with an opaque material and provide adequate air circulation above and around the pipe as required to prevent excessive heat accumulation.
3. Secure and maintain a location to store the material in accordance with Section 01 66 00.

1.11 FIELD CONDITIONS [NOT USED]

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 EQUIPMENT, PRODUCT TYPES, MATERIALS

A. Manufacturers
   1. Only the manufacturers as listed on the City's Standard Products List will be considered as shown in Section 01 60 00.
      a. The manufacturer must comply with this Specification and related Sections.
   2. Any product that is not listed on the Standard Products List is considered a substitution and shall be submitted in accordance with Section 01 25 00.
   3. The services and appurtenances shall be new and the product of a manufacturer regularly engaged in the manufacturing of services and appurtenances having similar service and size.

B. Materials/Design Criteria
   1. Service Line and Fittings (including wye connections)
      a. Service line pipe and fittings shall meet the requirements and be of the same material as the corresponding main line pipe to which it is connected.
         1) PVC Pipe and Fittings
            a) City Right-of-Way
               (1) In accordance with Section 33 05 31 or 33 05 32.
               (2) Pipe shall be green in color. Any discoloration in the pipe shall be sufficient cause for rejection.
         2) Private plumbing
            a) Schedule 40 in accordance with ASTM D1785.
         3) Ductile Iron Pipe and Fittings
            a) Lined with ceramic epoxy in accordance with Section 33 05 19.
         4) HDPE Pipe and Fittings
            a) In accordance with Section 33 05 33.
   2. Service saddle
      a. Only allowed when connecting a new service to an existing sanitary sewer main
      b. "Inserta Tee" type service connections preferred.
      c. Be a 1-piece prefabricated saddle, either polyethylene or PVC, with neoprene gasket for seal against main

d. Use saddle to fit outside diameter of main
e. Use saddle with grooves to retain band clamps
f. Use at least 2 stainless steel band clamps for securing saddles to the main

3. Cleanout and Box
   a. Unpaved Areas per City Standard Details.
   b. Paved Areas per City Standard Details
4. Coupling
   a. For connections between new PVC pipe stub out and existing service line, use rubber sleeve couplings with stainless steel double-band repair sleeves with shear guard to connect to the line.
   b. Follow manufacturer recommendations for all pipe materials.

2.2 ACCESSORIES [NOT USED]

2.3 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS

A. A licensed plumber is required for installations of the service line on private property.

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION [NOT USED]

3.4 INSTALLATION

A. General
   1. Install service line, fittings, and cleanouts in accordance with this Section, Section 33 05 06, and the pipe manufacturer's recommendations.

B. Handling
   1. Haul and distribute service lines, fittings, and cleanouts at the project site and handle with care to avoid damage.
      a. Inspect each segment of service line and reject or repair any damaged pipe prior to lowering into the trench.
   2. Do not handle the pipe in such a way that will damage the pipe.

C. Service Line
   1. All service leads shall be constructed per the City Detail.
   2. Sewer service leads shall be installed integrally with the construction of the sewer main, where possible, using "All Bell" gasket fittings.
   3. The minimum service connection shall be six (6) inches in diameter and 4 inch for single connections where approved.
   4. Direct taps on an existing PVC sewer main shall be Inserta Tee.
   5. Risers or vertical stacks shall be required for service leads to sewer mains eight (8) feet and deeper. Connection fittings and pipe material shall be same as specified above.

6. Lay service line at a minimum grade of 2 percent, as shown on City Standard details, or at lines and grades as indicated in the Drawings.
7. If service line is installed by bore as an alternative to open cut, the cost associated with open cut installation, such as pavement removal, trenching, embedment, backfill, and pavement patch will not be included as part of the bore installation.
8. Excavate and backfill trenches in accordance with 33 05 06.
9. Embed pipe in accordance with 33 05 06.

D. Cleanout
1. Install out of paved areas such as driveways, streets, and sidewalks whenever possible.
   a. When not possible, install cast iron boot and cap and reference the City Standard Details.

E. Service line connection to main
1. Orient fitting at the 10:00 or 2:00 position.
2. New service on new or replacement main
   a. Determine location of service connections before main installation so the service fittings can be installed during main installation.
   b. Connect service line to main with an Inserta Tee.
3. Reconnection to main after pipe enlargement or slip lining
   a. Tapping the existing main and installing a strap on wye connection may be used.
   b. Allow the new main to recover from imposed stretch before tapping and service installation.
      1) Follow manufacturer's recommendation for the length of time needed.
   c. Extend service line from main to property line or easement line before connecting to the existing service line.
4. New service on existing main
   a. Connect service line to main with Inserta Tee.
   b. Tapping the existing main and installing a strap on wye connection may be used if approved.

F. Service Taps into Manholes
1. Chipping into manhole will not be allowed.
2. Service taps into existing manholes shall be a minimum of 6-inches in diameter and be made by means of core cutting into the manhole with approved equipment.
3. The core cut shall be of sufficient size as to allow for 6-inch service line and approved gasket type (Link-Seal) sealing material.
4. Upon passing inspection the core cut shall be grouted over with Quikrete or approved equal non shrink grout inside and out per ASTM C1107.
5. On inside of manhole, all exposed cured grout and any concrete exposed from tap shall be coated with Thane Coat or approved equal, feathered out onto manhole wall a minimum of 6 inches from edge of core cut.

G. Private Service Relocation
1. Requirements for the relocation of service line on private property:
   a. A licensed plumber must be used to install service line on private property.

b. Obtain permit from City for Work on private property.
c. Pay for any inspection or permit fees associated with Work on private property.
d. Verify (by Exploratory Excavation of Existing Utilities) the elevations at the building cleanout and compare to data on the Drawings before beginning service installation.
e. Submit elevation information to the City inspector.
f. Verify the 2 percent slope installation requirement can be met.
    1) If the 2 percent slope cannot be met, verify with the City that the line may be installed at the lesser slope.

H. Saddles

1. Saddles shall be installed in accordance with manufacturer's recommendation.
2. Holes for saddle connections shall be made by a mechanical hole cutter to conform to the fitting.

3.5 REPAIR [NOT USED]

3.6 RE-INSTALLATION

A. Service Relocation

1. All relocations that are not installed as designed or fail to meet the City code shall be reinstalled at the Contractor’s expense.

3.7 FIELD QUALITY CONTROL

A. Inspections

1. Private property service line requires approval by the City plumbing inspector before final acceptance.
2. Cleanout stack shall be vertical and cleaning wye should be visible from the cleanout above. If cleanout stack is not vertical and the cleanout wye is not visible, then the cleanout stack must be re-installed at no additional cost.

END OF SECTION

SECTION 33 31 30

INTERIOR PROTECTIVE COATINGS FOR SANITARY SEWER STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Application of a corrosion protection coating system to concrete utility structures such as manholes, lift station wet wells, junction boxes, or other concrete facilities that may require protection from corrosive materials.
      a. This covers rehabilitation of existing sanitary sewer structures and newly installed sanitary sewer structures.
   2. Structures to be coated include all force main discharge manholes, pre-cast manholes, junction structures, lift station wet wells, the manhole preceding a wet well, and any other manhole or structure as specified in the Drawings.

B. Related Specification Sections include but are not limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 33 01 14 – Sewer and Manhole Testing.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. Manholes
      a. Measurement
         1) Measured per vertical foot of coating, as measured from the benching to the bottom of the grade rings for new Cast-in-Place manhole installation and from the benching to the bottom of the frame for all types of manhole rehabilitations.
      b. Payment
         1) The Work performed and materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid per vertical foot of “Manhole Liner” applied for:
            a) Various sizes.
            b) Various types.
      c. The price bid shall include:
         1) Removal of roots
         2) Removal of existing liner
         3) Eliminating any leaks
         4) Removal of steps
         5) Repair/seal connection of the existing frame to chimney
         6) Repairs of any cracks in the existing structure chimney, corbel (cone), wall, bench, including any replacement of damaged rebar, and pipe
         7) Surface cleaning and preparation
         8) Furnishing and installing liner as specified by the Drawings

9) Hauling
10) Disposal of excess material
11) Site Clean-up
12) Manhole and Invert Cleaning
13) Testing

2. Non-Manhole Structures
   a. Measurement
      1) Measured per square foot of area where the liner is applied.
   b. Payment
      1) The Work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid per square foot of "Structure Liner" applied.
   c. The price bid shall include:
      1) Removal of roots
      2) Removal of existing liner
      3) Eliminating any leaks
      4) Removal of steps
      5) Repair/seal connection of the existing frame to chimney
      6) Repairs of any cracks in the existing structure chimney, corbel (cone), wall, bench, including any replacement of damaged rebar, and pipe
      7) Surface cleaning and preparation
      8) Furnishing and installing Liner as specified by the Drawings
      9) Lining of wet well floor in new applications only
      10) Hauling
      11) Disposal of excess material
      12) Site Clean-up
      13) Manhole and Invert Cleaning
      14) Testing

1.3 REFERENCES

A. Definitions
   1. Liner – Mechanical installation.
   2. Coating – Spray or manual installation

B. Reference Standards
   1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
   2. ASTM International (ASTM):
      a. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
      b. D638, Standard Test Method for Tensile Properties of Plastics.
      c. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
      d. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

e. D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
f. D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.

3. The Society for Protective Coatings/NACE International (SSPC/NACE):
   a. SP 13/NACE No. 6, Surface Preparation of Concrete.
   b. SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sequencing
   1. All paving activities, including any final grade adjustments for manholes outside pavement, shall be completed before Contractor begins lining Work.
   2. After liner installation, Contractor shall wait a minimum of 48 hours to allow the liner material to fully cure before returning the system to normal service.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to delivery.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data
   1. Technical data sheet on each product used.
   2. Material Safety Data Sheet (MSDS) for each product used.
   3. Technical data sheet and project specific data for repair materials to be top-coated with the lining product including application, cure time, and surface preparation procedures.
   4. Material and method for repair of leaks or cracks in the structure. For repair Work on existing structures, manholes.
   5. Newly installed manholes (including Developer projects) that have been identified with cracks, voids, signs of infiltration, other structural defects, or other related construction damage.

B. Certification
   1. Current documentation from coating product manufacturer certifying Contractor's training (and/or licensure) as an approved installer and equipment compliance with the Quality Assurance requirements.

1.7 CLOSEOUT SUBMITTALS

A. Testing Documentation
   1. Provide test results required in Article 3.7 to City.
      a. Include the following manhole or structure location information:
         1) Station number.
         2) GIS ID number, if provided during construction.
      b. Inspection report of each manhole/structure tested.

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE

A. Qualifications
   1. Contractor
      a. Trained by, or have training approved and certified by, the coating product manufacturer for the handling, mixing, application, and inspection of the coating product(s) to be used.
      b. Initiate and enforce quality control procedures consistent with the lining product(s) manufacturer recommendations and applicable NACE or SSPC standards.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements
   1. Secure and maintain a location to store the material in accordance with Section 01 66 00.
   2. Keep materials dry, protected from weather, and stored under cover.
   3. Store lining materials per manufacturer's recommendation.
   4. Do not store near flame, heat, or strong oxidants.
   5. Handle lining materials according to their material safety data sheets.

1.11 FIELD CONDITIONS

A. Provide confined space entry, flow diversion, and/or bypass plans as necessary to perform the specified Work. Active flows shall be diverted with flow through plugs as required to ensure that flow is maintained off the surfaces to be lined.

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-FURNISHED PRODUCTS [NOT USED]

2.2 EQUIPMENT, PRODUCT TYPES, MATERIALS

A. Manufacturers
   1. Only the manufacturers as listed on the City's Standard Products List will be considered as shown in Section 01 60 00.
      a. The manufacturer must comply with this Specification and related Sections.
   2. Any product that is not listed on the Standard Products List is considered a substitution and shall be submitted in accordance with Section 01 25 00.

B. Repair and Resurfacing Products
   1. Compatible with the specified coating product(s) in order to bond effectively, thus forming a composite system
   2. Used and applied in accordance with the manufacturer's recommendations

C. Lining Product

1. Capable of being installed and curing properly within a manhole or other concrete structure.
2. Resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems, and capable of adhering to typical manhole structure substrate

D. Coating Application Equipment
1. Manufacturer approved, heated, plural component spray equipment.
2. Hard to reach areas, primer application, and touch-up may be performed using hand tools.
3. Applicator shall use approved specialty equipment adequate in size, capacity, and number sufficient to accomplish the Work in a timely manner.

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS

A. All installers shall be certified applicators approved by the manufacturers. Applicator shall use adequate number of skilled, trained, experienced workmen for the approved product.

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION

A. Manhole Preparation
1. Manhole preparation shall be per manufacturer's recommendations

B. Surface Preparation
1. Remove oils, roots, grease, incompatible existing coatings, linings, waxes, form release, curing compounds, efflorescence, sealers, salts or other contaminants which may affect the performance and adhesion of the lining to the substrate.
2. Remove any steps found in the structure.
3. Remove concrete and/or mortar damaged by corrosion, chemical attack, or other means of degradation so only sound substrate remains.
4. Surface preparation method, or combination of methods, to be used are high pressure water cleaning, high pressure water jetting, abrasive blasting, shotblasting, grinding, scarifying, detergent water cleaning, hot water blasting, and others in accordance with SSPC SP 13/NACE No. 6.
5. All methods used shall be performed in a manner that provides a uniform, sound, clean, neutralized, surface suitable for the specified lining product.
6. After completion of surface preparation, inspect for leaks, cracks, holes, exposed rebar, ring and cover condition, invert condition, and inlet/outlet pipe condition.
7. After defects in the structure have been identified, seal cracks, repair exposed rebar with new rebar to match existing, repair leaks and cracks with grout or other methods approved by the Manufacturer.

a. All new rebar shall be embedded in 1 1/2-inch epoxy mastic.
b. Replace/seal connection between existing frame and chimney if found loose or not attached.

3.4 INSTALLATION

A. General
1. Perform coating after the sewer line installation/repairs, grade adjustments, and grouting are complete.
2. Perform application procedures in accordance with the recommendations of the lining product manufacturer, including environmental controls, product handling, mixing, and application.

B. Temperature
1. Only perform application if surface temperature is per manufacturer's recommendations.
2. Make no application if freezing is expected to occur inside the manhole within 24 hours after application.

C. Coating
1. Spray apply in accordance with the manufacturer's recommendation at a minimum film thickness as noted in Section 2.2.
2. Apply coating from and including the bench to the bottom of the grade rings for new installations and to the bottom of the frame for rehab projects.
3. After walls are lined, remove bench covers and spray bench/trough to at a minimum the same thickness as the walls.
4. Apply any topcoat or additional coats within the product's recoat window.
a. Additional surface preparation is required if the recoat window is exceeded.
5. Allow a minimum of 3 hours of cure time or be hard to touch before reactivating flow.

3.5 REPAIR [NOT USED]

3.6 RE-INSTALLATION [NOT USED]

3.7 FIELD QUALITY CONTROL

A. Each structure will be visually inspected by the City the same day following the application.

B. Groundwater infiltration of the system shall be zero.

C. All pipe connections shall be open and clear.

D. The inspector will check for deficiencies, pinholes, voids, cracks, uncured spots, delamination, and thin spots. Any deficiencies in the liner shall be marked and repaired according to the procedures outlined by the Manufacturer.

E. If leaks are detected they will be chipped back, plugged, and coated immediately with protective epoxy resin lining.
1. Make repair 24 hours after leak detection.

F. Lining Thickness Testing
1. Wet Film Thickness Testing

a. Take wet film thickness gauge measurements in accordance with ASTM D4414 at 3 locations within the manhole, 2 spaced equally apart along the wall and 1 on the bench.
   1) Document and attest measurements and provide to the City.

2. Thickness Testing for modified polymer liner system
   a. Upon installation of the Final Corrosion Barrier, insert probe into substrate for depth of system measurement at 3 locations within the manhole, 2 spaced equally apart along the wall and 1 on the bench.
      1) Document and attest measurements and provide to the City.

G. Post Installation Lining Tests
   1. Holiday Detection Testing
      a. Holiday Detection test the liner in accordance with NACE SP0188. Mark all detected holidays. Repair all holidays in accordance to coating manufacturer's recommendations.
         1) Document and attest all test results and repairs made, and provide to the City.
         2) Contractor shall mark any location that shows a spark or potential for a pinhole and repair these locations in accordance with manufacturer recommendations.

H. Non-Conforming Work
   1. City reserves the right to require additional testing depending on the rate of failure.
      a. City will select testing locations.
   2. Repair all defects according to the manufacturer's recommendations.

3.8 SYSTEM STARTUP [NOT USED]

3.9 ADJUSTING [NOT USED]

3.10 CLEANING [NOT USED]

3.11 CLOSEOUT ACTIVITIES [NOT USED]

3.12 PROTECTION [NOT USED]

3.13 MAINTENANCE [NOT USED]

3.14 ATTACHMENTS [NOT USED]

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 33 32 00
NON-CLOG SUBMERSIBLE SEWAGE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Contractor shall furnish all labor, materials, equipment and incidentals required to provide non-clog submersible centrifugal sewage pumps that will include: three (3) for the sanitary lift station all with base elbow discharge assemblies and guide rail stations as specified herein and shown on the plans. Contractor shall provide services of manufacturer's representative for a complete start-up supervision and O&M instruction.

1.02 QUALITY ASSURANCE:

A. References:

American National Standards Institute (ANSI)
Factory Mutual
ASTM A48 Gray Iron Fittings
Hydraulic Institute Standards ASTM B48 Brass
National Electric Code (NEC)
Steel Structures Painting Council (SSPC)

1.03 SUBMITTALS:

A. Contractor shall submit documentation of warranty, including specific items covered and time periods.

B. Contractor shall submit test results for submersible pumps as described in Section 2.10 of this specification.

C. Contractor shall submit performance data (pump curves, flow tests, etc.) for the pumps being installed under this contract. Submittal data must include the following:

D. Pump Performance Curves. The performance curves submitted for approval shall state in addition to head and capacity performance, the pump efficiency, solid handling capacity, and reflect motor service factor.

1. Pump Outline Drawing.

2. Station Drawing for Accessories.

3. Electrical Motor Data.
4. Control Drawing and Data.
5. Access Frame Drawing.
6. Typical Installation Guides.
7. Technical Manuals.
8. Parts List.
9. Printed Warranty.
10. Manufacturer's Equipment Storage Recommendations.
11. Manufacturer's Standard Recommended Start-Up Report Form.

E. Contractor shall submit location and description of service centers and spare parts stock.

1.04. WARRANTY:

A. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the unit(s) restored to service at no expense to the Owner. Warranty shall be for a period of two (2) years and begin on the same date as the maintenance bond.

B. The Contractor shall also furnish a “trouble shooter” within twenty-for (24) hours from notification to repair any malfunction with any unit purchased under this contract for the duration of that unit’s warranty.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products in accordance with manufacturer’s latest published requirements and specifications.

PART 2 PRODUCTS

2.01 Pumps

A. Lift Station Pump Requirements

1. The three (3) pumps shall be a submersible non-clog wastewater pump. Each pump shall be equipped with a 35 HP or less submersible electric explosion-proof motor, connected for operation on 460 volts, three phase, 60 Hertz,

1755 R.P.M. or less. The power cable shall be long enough to reach the pump controls without splicing and sized according to NEC and ICEA standards and also meet with P-MSHA Approval.

2. Pumps shall be:

   a. Flygt NP 3171 MT 3˜ 435 or

   b. Pre-approved equal.

SUBMERSIBLE PUMP PERFORMANCE DATA

Number of required units .....Two (2) + One (1) standby

Rated Condition

Operating Point 1 (2 pumps running)

Capacity (Flow).....4164 GPM

Head .....42.80 Feet (TDH)

Minimum Shutoff Head .....50 Feet

Minimum motor horsepower required .....25 HP

Electrical Characteristics Required .....460 Volt 60 Hz. 3 Ph.

Maximum pump operating speed .....1755 RPM

Minimum Discharge Size.....Six (6) inches

Minimum Solid Size required to pass through Impeller.....Three (3) inches diameter

Liquid to be Pumped .....Wastewater

Minimum Efficiency…….71%

B. Pump Construction

1. Provide pumps capable of handling raw unscreened wastewater. Design pumps to allow for removal and reinstallation without the need to enter the wet well and without removal of bolts, nuts or other fasteners. Provide a pump which connects to a permanently mounted discharge connection by simple downward motion, without rotation, guided by at least two non-load-bearing guides. All guide system components, including cable or pipe guides, shall be supplied and warranted by the pump manufacturer. Pump guide rails shall be fastened to the discharge elbow to prevent dislodging when subjected to upward force. Guides shall be suitable for proper operation when installed at up to 5-degree misalignment from vertical. Intermediate guide supports (between upper bracket and discharge elbow connections) shall not be required or used. Final connection shall insure zero leakage between pump and discharge connection flange. Provide a discharge connection/ guide system so that no part of the pump bears directly on the floor of the wet well. Provide Type 316 stainless steel chain of sufficient length to properly and safely lift pumps from the wet well. All exposed cast iron and ferrous surfaces shall be cleaned of dirt and grease, sandblasted to near white finish, and coated with an anti-corrosion reaction primer. The pump shall then be coated with two-component thick coat paint, with an epoxy resin base, having at minimum 83% solids by volume. This coating shall be non-toxic and approved for both wastewater and water applications. The pump casing, impeller, motor housing and stationary base elbow shall be manufactured of close-grained cast iron, ASTM A48, Class 35B.

2. Furnish major components (pump case, impeller, intermediate housing, motor housing) of cast material as specified with smooth surfaces devoid of blow holes and other irregularities. Pump case design shall incorporate a centerline discharge for stability when mounted on the base elbow.

3. Major pump components shall be of gray cast iron, Class 35B, with smooth surfaces devoid of blow holes and other irregularities. Where water-tight sealing is required, "O"-rings made of nitrile rubber shall be used. All exposed nuts and bolts shall be of AISI Type 304 stainless steel construction. All surfaces coming into contact with sewage, other than stainless steel or brass, shall be protected by an approved sewage resistant coating. Pump exterior shall a finish of a two-part Epoxy coating.

C. Motor

1. Provide a motor which is squirrel cage, induction in design, housed in a completely watertight and air-filled chamber, with a min 1.15 service factor. Insulate the motor stator with, at minimum, Class F insulation rated for 311

Degrees F. Provide temperature protection and seal leak detection as described in section 2.3. Provide adequately rated motor with sufficient surface area for ambient only cooling without the need for oil circulation systems or submergence (cooling) jackets which circulate pumped media for motor cooling. If cooling jackets are provided, they must be designed to pass 3" wastewater solids (or to filter out all solids) while maintaining a minimum 2 ft/sec non-settling velocity of coolant at all anticipated pump operating speeds. Provide motors which are capable of operating for unlimited periods of time in a dry mode without damage to motor or seals (motors rated for "short duty in air" or "15 minutes in air" will not be acceptable). Provide motors which are designed, rated and warranted for continuous operation. Do not provide motors which contain in excess of two (2) gallons of oil (combined total for cooling and seals), or which contain other than ecologically safe parifin base or mineral base oil.

2. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80° C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

3. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 70 feet or greater.

4. The top end bracket shall be fitted with a lifting bail and shall be capable of supporting four (4) times the combined weight of the pump and motor.

D. Bearings

1. Furnish upper and lower bearings, single row or double row as needed to provide a B10 life of, at minimum, 100,000 hours at all anticipated axial and radial loadings. Provide sealed/shielded (permanently lubricated) bearings. If open-type (non-shielded) bearings are used, provide re-lubrication ports with positive anti-leak plugs for periodic addition of lubrication from external to the pump available from third party sources other than the pump/motor manufacturer.

E. Mechanical Seals

1. Provide two totally independent mechanical shaft seals silicon carbide vs. silicon carbide, installed in tandem, each with its own independent single

spring system acting in a common direction. Install the upper seal in an oil-filled chamber with drain and inspection plug (with positive anti-leak seal) for easy access from external to the pump. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced. Provide seals with replacements available. Do not provide seals with the following characteristics: conventional double mechanical seals with single or multiple springs acting in opposed direction; cartridge-type mechanical seals; seals incorporating coolant circulating impellers, seals with face materials other than those specified.

F. Pump Shaft

1. Provide common pump/motor shaft of sufficient size to transmit full driver output with a maximum deflection of 0.002 inches measured at the lower mechanical seal. Machine the shaft of carbon steel (for maximum strength and motor efficiency) and isolate the shaft from the pumped media with a replaceable Type 420 stainless steel shaft sleeve under the lower mechanical seal. Do not use carbon steel as shaft material without a stainless-steel sleeve. If a sleeve is not used, machine the entire pump/motor shaft of ASTM A276 Type 420 stainless steel.

G. Impeller

1. Provide non-clog type impeller, capable of passing at minimum a 3" spherical solid. Statically and dynamically balance the impeller. On enclosed impeller designs, provide hard metal wear rings of material and Brinell hardness specified, to insure maximum pump/impeller life and continuing high efficiencies. Impellers must incorporate back vanes that reduce axial loads and propel solids away from the seal area. Do not use soft metals (i.e. bronze, 304 or 316 stainless) or elastomers as wear ring material as these are incompatible with the grit contaminate expected in the pumpage.

H. Shielded Power Cable

1. Provide sufficient length of power/control cable with each pump, suitable for submersible wastewater application, sized in accordance with NEC requirements. Provide cable terminal box on side of motor housing, with cable entry sealed to insure that no entry of moisture is possible into the high-voltage motor/ terminal area even if the cable is damaged or severed below water level. Cable seal shall include a compressed rubber grommet to seal the cable exterior and epoxy fill to seal the interior passages. A strain relief device, in direct contact with both the cable and the cast iron entry housing, shall be provided. The cable entry shall be rated by Factory Mutual (or UL) for submerged operating depths to 85 feet.

I. Protection

1. Furnish temperature monitoring devices in motor windings for use in conjunction with and supplemental to external motor overload protection. Arrange controls to shut down pump should any of the monitors detect high temperature and automatically reset once motor temperature returns to normal. Set temperature monitors at levels recommended by pump manufacturer.

2. Provide a detector in the motor's stator cavity, which allows a control panel mounted relay to indicate leakage into the motor. Electronic probes which depend on sensing resistance value changes in seal oil will not be acceptable as seal leak indicators.

3. The pump supplier shall furnish all relays required for monitoring all motor sensors. The relays shall be installed by others in the motor control panel and properly wired in accordance with pump manufacturer's instructions. Relays shall mount in standard 12-pin socket bases and shall operate on available control voltage of 24-240 VAC. If relays require an input voltage that is not available in the motor control panel an adequate transformer (with fused input) shall be provided by the pump supplier. Relays shall have a power consumption of no more than 2.8 watt, and shall be UL approved. Relays shall be modular in design, with each relay monitoring no more than two motor sensor functions. Each relay module shall include a dual color (red/green) LED to indicate the status of each monitored sensor. Green will indicate "status OK"; red will indicate a failure or alarm condition. A self-corrected fault will allow the relay output contacts to reset, and cause the LED to change from a steady alarm indication to a flashing signal. The LED shall continue to flash until locally cleared, providing the operator an indication of a potential intermittent fault. Each relay shall also include a power-on LED and both "test" and "reset" pushbuttons. An independent fail-safe (switch on power loss) form-C output contact shall be included for each monitored sensor to provide a normally-open / normally-closed dry contact to initiate a remote alarm device or shut down the motor. Contacts shall be rated for 5 amps at 120 volt.

J. All external hardware including nameplates on the pump/motor shall be 316 Series stainless steel.

2.02 Variable Frequency Drives

A. The lift station pumps shall be equipped with a variable frequency drive furnished by the pump supplier.

B. Variable frequency drives shall be furnished in accordance with Section 26 29 23.

PART 3 EXECUTION

3.01 GENERAL:

A. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.

B. The Contractor shall provide a supervisor at the work site during all construction operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

C. The Contractor and all workmen employed by him shall conduct all operations in a clean and sanitary manner and in conformance with all aspects of the contract documents.

3.02 START-UP:

A. The equipment manufacturer shall furnish the services of a qualified factory trained field service engineer for 8-hour working day(s) at the site to inspect the installation and instruct the owner's personnel on the operation and maintenance of the pumping units. After the pumps have been completely installed and wired, the contractor shall have the manufacturer do the following:

1. Megger stator and power cables.
2. Check seal lubrication.
3. Check for proper rotation.
4. Check power supply voltage.
5. Measure motor operating load and no load current.
6. Check level control operation and sequence.

B. During this initial inspection, the manufacturer's service representative shall review recommended operation and maintenance procedures with the owner's personnel.

C. The Contractor shall provide services of the manufacturer’s representative as needed to ensure proper installation of equipment and to provide start-up supervision and O&M instruction.

3.03 TESTING

A. All pumps shall be site tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation or over-heating. Site tests shall be conducted by the manufacturer or his Authorized Representative.

1. Tests shall include checking for correct rotation, maximum motor amperage draws within nameplate specifications, balanced voltages on each power leg with the pump operating to within manufacturers' tolerances, and demonstrated compatibility of the pump/motor with the controls supplied.

2. Each pump shall be submerged in water.

3. Motor and cable insulation shall be tested for moisture content or insulation defects.

4. Test results shall be in printed form and signed by the manufacturer or his representative and supplied to the Owner.

B. A non-witnessed certified Hydraulic Institute performance test shall be performed. This shall include the following.

1. The pump with motor shall be tested at the design point as well as at least 7 other points to develop a curve. Data shall be collected to plot the head-capacity curve as well as a KW input and amperage curve.

2. In making these tests, no minus tolerance or margin shall be allowed with respect to capacity, total head, or efficiency at the specified design condition. Pump shall be held within a tolerance of +10% of rated capacity or at rated capacity with a tolerance of +5% of rated head. The pump shall be tested at shut-off but shall not be plotted and only used as a reference point when plotting the performance curve.

3. Complete records shall be kept of all information relevant to the test as well as the manufacturer's serial number, type and size of pump as well as any impeller modifications made to meet the design conditions.

4. A written test report shall be prepared, signed and dated by the test engineer incorporating 3 curves (head-capacity, KW input, and amperage) along with the pump serial number, test number, date, speed, volts, phase, and impeller diameter. This report shall then be submitted to the Engineer for approval.

END OF SECTION

SECTION 33 32 01
ACCESS HATCHES

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Furnish all labor, materials, equipment and incidentals required to completely install and put into operation, wet well and valve vault access hatches as specified herein and shown on the drawings.

1.02 QUALITY ASSURANCE:

A. References:

ASTM A36-93a Structural Steel

1.03 SUBMITTALS:

A. Contractor shall submit manufacturer's technical information for the wet well and valve vault access hatches.

1.04. WARRANTY:

Manufacturer shall guarantee against defects in material or workmanship for a period of five (5) years.

PART 2 PRODUCTS

2.01 ACCESS HATCHES:

A. The contractor shall furnish and install one (1) wet well access hatch as manufactured by the Bilco Company, Halliday Products or approved equal, as shown on the plans.

B. The door leaf shall be 1/4" aluminum diamond pattern plate. The door shall withstand a live load of 300 lb./sq. ft. with a maximum deflection of $1/150^{th}$ of the span.

C. Drop handle shall be cast aluminum and flush with door leaf.

D. Channel frame shall be 1/4" aluminum with an anchor flange around the perimeter and shall have a minimum cross-sectional area of 7-1/2 sq. in. to allow for proper water drainage. Door shall be equipped with type 316 stainless steel hinge having 3/8"

minimum diameter stainless steel pins and pivot so that the cover does not protrude into the channel frame.

E. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. The door shall automatically lock in the vertical position by means of a heavy steel hold-open arm with release handle. Locking mechanism shall consist of recessed hasp covered by a hinged lid flush with surface. A 1-1/2" drainage coupling shall be located in the front right corner of the channel frame. Hardware and all fasteners shall be Type 316 stainless steel.

F. Factory finish shall be mill-finish aluminum with a bituminous coating applied to the exterior of the frame.

G. Installation shall be in accordance with the manufacturer's instructions. The drains shall be directed into the wet well.

H. Access hatches shall be equipped with HatchNet 121 safety nets as manufactured by Safe Approach, or approved equal.

PART 3 EXECUTION

3.01 GENERAL:

A. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.

B. The contractor shall provide a supervisor at the work site during all construction operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

C. The contractor and all workmen employed by him shall conduct all operations in a clean and sanitary manner and in conformance with all aspects of the contract documents.

END OF SECTION

SECTION 33 39 14

EPOXY LINERS FOR CONCRETE MANHOLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Application of a high-build epoxy coating system to concrete utility structures such as manholes, junction boxes or other concrete facilities that may need protection from corrosive materials.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract
2. Division 01 – General Requirements

1.02 REFERENCES

A. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
2. ASTM International (ASTM):
   a. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
   b. D638, Standard Test Method for Tensile Properties of Plastics.
   c. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
   d. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   e. D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
   f. D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
   g. D4541, Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers.
3. Environmental Protection Agency (EPA).
4. NACE International (NACE).
5. Occupational Safety and Health Administration (OSHA).
6. Resource Conservation and Recovery Act, (RCRA).

7. The Society for Protective Coatings/NACE International (SSPC/NACE): sp13/NACE No. 6, Surface Preparation of Concrete

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 23.

B. All submittals shall be approved by the Engineer or the City prior to delivery.

1.04 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data: Technical data sheet on each product used.

B. Material Safety Data Sheet (MSDS) for each product used.

C. Copies of independent testing performed on the coating product indicating the product meets the requirements as specified herein.

D. Technical data sheet and project specific data for repair materials to be topcoated with the coating product including application, cure time and surface preparation procedures.

E. Contractor Data.

F. Current documentation from coating product manufacturer certifying Contractor's training and equipment complies with the Quality Assurance requirements specified herein.

G. 5 recent references of Contractor indicating successful application of coating product(s) of the same material type as specified herein, applied by spray application within the municipal wastewater environment.

1.05 QUALITY ASSURANCE

A. Qualifications: Contractor shall be trained by, or have training approved and certified by, the coating product manufacturer for the handling, mixing, application and inspection of the coating product(s) to be used as specified herein.

B. Initiate and enforce quality control procedures consistent with the coating product(s) manufacturer recommendations and applicable NACE or SSPC standards as referenced herein.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Keep materials dry, protected from weather and stored under cover.

B. Store coating materials between 50 degrees F and 90 degrees F.

C. Do not store near flame, heat or strong oxidants.

D. Handle coating materials according to their material safety data sheets.

1.07 FIELD [SITE] CONDITIONS

A. Provide confined space entry, flow diversion and/or bypass plans as necessary to perform the specified work.

1.08 WARRANTY

A. Contractor Warranty.

PART 2 PRODUCTS

2.01 MATERIALS, EQUIPMENT, PRODUCT TYPES

A. Repair and Resurfacing Products: Compatible with the specified coating product(s) in order to bond effectively, thus forming a composite system.

B. Used and applied in accordance with the manufacturer's recommendations.

C. The repair and resurfacing products must meet the following:

1. 100 percent solids, solvent-free epoxy grout specifically formulated for epoxy top coating compatibility
2. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be toweled or pneumatically spray applied and specifically formulated to be suitable for top coating with the specified coating product used

D. Coating Product: Capable of being installed and curing properly within a manhole or concrete utility environment.

E. Resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems; and, capable of adhering to typical manhole structure substrates

F. The 100 percent solids, solvent-free ultra-high-build epoxy system shall exhibit the following characteristics:

1. Application Temperature – 50 degrees F, minimum
2. Thickness – 125 mils minimum
3. Color – White, Light Blue, or Beige
4. Compressive Strength (per ASTM D695) – 8,800 psi minimum
5. Tensile Strength (per ASTM D638) – 7,500 psi minimum.
6. Hardness, Shore D (per ASTM D4541) – 70 minimum
7. Abrasion Resistance (per ASTM D4060 CS 17F Wheel) – 80 mg loss maximum
8. Flexural Modulus (per ASTM D790) – 400,000 psi minimum
9. Flexural Strength (per ASTM D790) – 12,000 psi minimum
10. Adhesion to Concrete, mode of failure (ASTM D4541): Substrate (concrete) failure
11. Chemical Resistance (ASTM D543/G20) all types of service for:

12. Municipal sanitary sewer environment
13. Sulfuric acid, 30 percent
14. Sodium hydroxide, 5 percent

G. Coating Application Equipment
   1. Manufacturer approved heated plural component spray equipment.
   2. Hard to reach areas, primer application and touch-up may be performed using hand tools.

2.02 SOURCE QUALITY CONTROL

A. Testing: Take wet film thickness gauge per ASTM D4414 at 3 locations within the manhole, 2 spaced equally apart along the wall and 1 on the bench.

B. Document and attest measurements and provide to the City.

C. After coating has set, repair all visible pinholes by lightly abrading the surface and brushing the lining material over the area.

D. Repair all blisters and evidence of uneven cover according to the manufacturer's recommendations.

E. Test manhole for final acceptance according to Section 33 01 30.

PART 3 EXECUTION

3.01 INSTALLERS

A. All installers shall be certified applicators approved by the manufacturers.

3.02 PREPARATION

A. Manhole Preparation: Stop active flows via damming, plugging or diverting as required to ensure all liquids are maintained below or away from the surfaces to be coated.

B. Maintain temperature of the surface to be coated between 40 and 120 degrees F.

C. Shield specified surfaces to avoid exposure of direct sunlight or other intense heat source.

D. Where varying surface temperatures do exist, coating installation should be scheduled when the temperature is falling versus rising.

E. Surface Preparation:
   1. Remove oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts or other contaminants which may affect the performance and adhesion of the coating to the substrate.

2. Remove concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation so that only sound substrate remains.
3. Surface preparation method, or combination of methods, that may be used include high pressure water cleaning, high pressure water jetting, abrasive blasting, shot blasting, grinding, scarifying, detergent water cleaning, hot water blasting and others as described in SSPC SP 13/NACE No. 6.
4. All methods used shall be performed in a manner that provides a uniform, sound, clean, neutralized, surface suitable for the specified coating product.

3.03 INSTALLATION

A. General: Perform coating after the sewer line replacement/repairs, grade adjustments and grouting are complete.

B. Perform application procedures per recommendations of the coating product manufacturer including: environmental controls, product handling, mixing and application.

C. Temperature: Only perform application if surface temperature is between 40 and 120 degrees F.

D. Make no application if freezing is expected to occur inside the manhole within 24 hours after application.

E. Coating: Spray apply per manufacturer's recommendation at a minimum film thickness of 125 mils.

F. Apply coating from bottom of manhole frame to the bench/trough, including the bench/trough.

G. After walls are coated, remove bench covers and spray bench/trough to at least the same thickness as the walls.

H. Apply any top coat or additional coats within the product's recoat window. Additional surface preparation is required if the recoat window is exceeded.

I. Allow a minimum of 3 hours of cure time or be set hard to touch before reactivating flow.

3.04 FIELD [OR] SITE QUALITY CONTROL

A. Each structure will be visually inspected by the City the same day following the application.

B. The inspector will check for deficiencies, pinholes and thin spots.

C. If leaks are detected they will be chipped back, plugged and coated immediately with protective epoxy resin coating.

D. Make repair 24 hours after leak detection.

3.05 CLOSEOUT ACTIVITIES

A. Upon final completion of the work, the manufacturer will provide a written certification of proper application to the City.

B. The certification will confirm that the deficient areas were repaired in accordance with the procedure set forth in this Specification.

END OF SECTION

No specifications on this page for formatting purposes.

No specifications on this page for formatting purposes.

SECTION 33 42 11

STORMWATER PIPE AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufacturer, material, and installation requirements for:
      a. Reinforced concrete pipe (circular, arch, and elliptical)
         1) RCP sizes under 18 inches are only permitted when written approval has been provided by the City Engineer prior to construction activities starting.
      b. Reinforced concrete box
         1) RCB extended curb is only permitted when written approval has been provided by the City Engineer prior to construction activities starting.
      c. Corrugated Metal Pipe
         1) Corrugated metal pipe is only permitted when written approval has been provided by the City Engineer prior to construction activities starting.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.3 REFERENCES

A. Abbreviations and Acronyms
   1. CMP – Corrugated Metal Pipe
   2. LRFD – Load Resistance Factor Design
   3. PSI – Pounds per Square Inch
   4. RCP – Reinforced Concrete Pipe
   5. RCB – Reinforced Concrete Box

B. Definitions
   1. Aluminized Steel Pipe=
      a. If aluminized steel pipe is referenced in the Drawings or specifications, aluminized steel pipe shall follow all requirements within this section for Corrugated Metal Pipe.
   2. RCB Curb and Extended Curb
      a. Any curb shorter than 12 inches from the top of the box to the top of the curb will be considered subsidiary to the RCB. Any curb taller than 12 inches will be included under RCB Extended Curb.

C. Reference Standards

1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
2. American Association of State Highway and Transportation Officials (AASHTO):
   a. AASHTO LRFD – AASHTO LRFD Bridge Design Specifications.
   b. M36, Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
   c. M170, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   d. M206, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.
   e. M207, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
   f. M259, Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers.
   g. M273, Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than Two Feet of Cover Subjected to Highway Loadings.
   h. M274, Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe.
3. American Society for Testing and Materials (ASTM):
   a. ASTM A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
   b. ASTM A929, Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.
   c. ASTM C76, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   d. ASTM C270, Standard Specification for Mortar for Unit Masonry.
   e. ASTM C443, Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.
   f. ASTM C506, Arch Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   g. ASTM C507, Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
   h. ASTM C655, Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe.
   i. ASTM C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
   j. ASTM C1433, Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers.
   k. ASTM C1577, Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designated According to AASHTO LRFD.
   l. ASTM C1619, Standard Specifications for Elastomeric Seals for Joining Concrete Structures.
   m. ASTM C1677, Standard Specification for Joints for Concrete Box, Using Rubber Gaskets.
4. Texas Department of Transportation (TxDOT) Departmental Material Specifications (DMS):
   a. DMS-7310, Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification.

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to purchasing of materials.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Shop Drawings:
   1. Product Data
      a. Reinforced Concrete Pipe and Reinforced Concrete Box
         1) Provide the following information on the product data submittal:
            a) Product Type
            b) Class of Concrete
            c) Average length of pipe or box section
            d) Type of jointing material used
            e) Manufacturer recommendations for storage, handling, and installation of pipe, boxes, and joints.
      b. Corrugated Metal Pipe
         1) Provide the following information on the product data submittal:
            a) Manufacturer product sheet for pipe and jointing material used.
            b) Manufacturer recommendations for storage, handling, and installation of pipe and joints.

B. Information Submittals:
   1. Certificates:
      a. Provide the manufacturer's certificate of compliance providing their product meets the physical testing requirements of this specification and DMS 7310 for the materials referenced which may include, but are not limited to:
         1) Concrete mix design and reinforcing
         2) Reinforced concrete pipe
         3) Reinforced concrete arch pipe
         4) Reinforced concrete elliptical pipe
         5) Reinforced concrete box
         6) Jointing materials
         7) Corrugated Metal pip
   2. Equipment Information
      a. Submittal for all major equipment to include:
         1) Equipment name and description
         2) Size
         3) Intended use

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements
   1. Secure and maintain a location to store the material in accordance with Section 01 66 00.

2. General
   a. Keep all pipes and boxes clean and drained during storage.
   b. Transport, handle, and store pipe, boxes, and fittings as recommended by the supplier or manufacturer.
   c. Replace any pipe or box that is damaged during transport prior to installation at no cost to the City.
3. Corrugated Metal Pipe
   a. Handle the pipe in accordance with the recommendations of the National Corrugated Steel Pipe Association.
4. Reinforced Concrete Pipe (RCP)
   a. Markings
      1) Mark each section of reinforced concrete pipe with the following information:
         a) Class of pipe
         b) ASTM designation
         c) Date of manufacture
         d) Pipe size
         e) Name or trademark of fabricator and plant location
         f) Designated fabricator's approval stamp
         g) Pipe to be used for jacking and boring (when applicable)
         h) Designation "SR" for pipe meeting sulfate-resistant concrete plan requirements (when applicable)
      2) Clearly mark 1 end of each section during manufacturing or immediately after for elliptical pipes.
      3) For Non-Circular Pipes: Mark the pipe on the inside and outside of opposite walls to show the location of the top or bottom of the pipe as it should be installed.
5. Reinforced Concrete Box
   a. Store and ship machine-made precast boxes in accordance with DMS-7310.
   b. Markings:
      1) Mark precast boxes with the following information:
         a) Name or trademark of manufacturer
         b) ASTM designation
         c) Date of manufacture
         d) Box size
         e) Minimum and maximum fill heights
         f) Designated fabricator's approval stamp
         g) Boxes to be used for jacking and boring (when applicable)
         h) Designation "SR" for boxes meeting sulfate-resistant concrete plan requirements (when applicable)
      2) Mark 1 end of each box section without lifting holes on the inside and outside walls to indicate the top or bottom as it will be installed.
      3) Indent markings into the box section or paint them on each box with waterproof paint.
6. Pre-Formed Flexible Joint Sealants
   a. Store pre-formed flexible joint sealants in an area warmed naturally or artificially to above 70 degrees Fahrenheit in an approved manner when the atmospheric temperature is below 60 degrees Fahrenheit.

1.11 FIELD CONDITIONS [NOT USED]

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-SUPPLIED PRODUCTS [NOT USED]

2.2 MANUFACURERS

A. Concrete (RCP and RCB):
   1. Class P:
      a. Provide Class P concrete in accordance with Section 03 00 00 with greater than 2 feet of cover, including top bedding.
   2. Class S:
      a. Provide Class S concrete in accordance with Section 03 00 00 with 0 to 2 feet of cover, including top bedding.
   3. Machine-Made Precast:
      a. Provide the class of concrete required based on available cover. Provide machine-made precast reinforced concrete box when possible in accordance with DMS-7310.
   4. Cast-in-Place:
      a. Provide the class of concrete required based on available cover. Conform to requirements in Section 03 30 00 and DMS-7310.
   5. Formed Precast:
      a. Not permitted for use.

B. Reinforcement (Cast-in-Place RCB):
   1. Provide grade 60 steel reinforcing in accordance with Section 03 00 00.
   2. Provide a minimum of 2 inches of cover on all reinforcing unless otherwise noted.

C. Reinforced Concrete Pipe (RCP):
   1. Circular Pipe
      a. In accordance with ASTM C76, ASTM C655, and AASHTO M170.
      b. Provide circular pipe based on the classes specified in the Drawings and Table 1. Provide the required class of pipe based on the pipe cover from:
         1) Top of ground to top of pipe
         2) Top of pavement to top of pipe
      c. If the Drawings do not show the correct pipe class based on cover, obtain written direction from the City prior to installing the pipe.

Table 1
Circular Pipe Class and D-Load

Pipe Class	D-Load	Minimum Pipe Cover (FT)
3 (III)	1,350	2
4 (IV)	2,000	1 to 2
5 (V)	3,000	Direct Traffic Loading (0 to 1)

2. Arch Pipe
   a. In accordance with ASTM C506 and AASHTO M206.
   b. Maintain a minimum 1-foot cover from top of ground or pavement to top of pipe.
   c. Provide arch pipe design sizes in accordance with Table 2.

Table 2
Arch Pipe

Design Size	Equivalent Diameter (in.)	Rise (in.)	Span (in.)
1	18	13.5	22
2	21	15.5	26
3	24	18	28.5
4	30	22.5	36.25
5	36	26 – 5/8	43.75
6	42	31 – 5/16	51 – 1/8
7	48	36	58.5
8	54	40	65
9	60	45	73
10	72	54	88

3. Elliptical Pipe
   a. In accordance with ASTM C507 and AASHTO M207
   b. Maintain a minimum 1-foot cover from top of ground or pavement to top of pipe.
   c. Provide elliptical pipe design sizes in accordance with Table 3.

Table 3
Elliptical Pipe

Design Size	Equivalent Diameter (in.)	Rise (in.)	Span (in.)
1	18	14	23
2	24	19	30
3	27	22	34
4	30	24	38
5	33	27	42
6	36	29	45
7	39	32	49
8	42	34	53
9	48	38	60
10	54	43	68

D. Reinforced Concrete Box (RCB)
   1. In accordance with ASTM C1433, AASTHO M259, and AASTHO M273.
   2. Lifting Holes:
      a. Provide no more than 4 lifting holes in each section for precast boxes.
      b. Lifting holes may be cast-in-place or drilled by manufacturer. Ensure no reinforcing has been cut.
      c. Provide lifting holes large enough for adequate lifting devices based on the size and weight of the box section.
      d. Use lifting holes no larger than 3 inches in diameter.
      e. Repair any spalled areas around lifting holes.
      f. Fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.

E. Corrugated Metal Pipe (CMP)
   1. When approved, provide corrugated metal pipe in accordance with Table 4.
   2. Provide pipe in a circular shape in sizes ranging from 18 inch to 24 inch.
      a. Provide reinforced concrete pipe for any pipe sizes larger than 24 inch.
   3. Only circular steel pipe will be allowed. For arch or elliptical pipe, use reinforced concrete pipe.
   4. Corrugated metal pipe is only permitted:
      a. In locations where the existing driveway culvert is a steel pipe.
      b. Within a developed site.
   5. Steel pipe will not be approved for use:
      a. Within the City's right-of-way
      b. As a connection to City storm sewer infrastructure from an off-site system
         1) A minimum of 50 feet of reinforced concrete pipe is required to connect to a City storm system.
   6. Provide any protective coating as required by the manufacturer.

Table 4
Specification for Corrugated Metal Pipe

Pipe Type	ASTM/AASHTO Specification
Aluminized Steel Type 2	ASTM A760/AASTO M36 & ASTM 929/AASHTO M274
Circular, Spiral Rib	Type IR

F. Jointing Materials
   1. Corrugated Metal Pipe
      a. Provide bands and joints in accordance with manufacturer's recommendations.
   2. Concrete Pipe and Box Joints and Fittings
      a. Use any of the following materials to make joints unless otherwise specified on the Drawings. Provide a manufacturer's certificate of compliance for all jointing materials except mortar.
         1) Rubber Gaskets:
            a) Type: ASTM C1619 Class A or C
            b) Provide gaskets in accordance with the requirements of ASTM C443 for design of the pipe joints and permissible variations in dimensions.
         2) Pre-Formed Flexible Joint Sealants:
            a) Used for sealing tongue-and-groove concrete pipe
            b) Joint Characteristics:
               (1) In accordance with the requirements of ASTM C990, and
               (2) do not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strengths,
               (3) are in extruded rope form, and
               (4) are in accordance with the manufacturer's recommendations for size and are large enough to properly seal the joint.
            c) Protect joint sealant with a suitable wrapper that maintains the integrity of the jointing material when the wrapper is removed.

G. Cast Iron Frame and Cover
   1. Provide a frame and cover marked "Storm Sewer" in accordance with Section 33 05 81.

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL

A. Tests and Inspections
   1. Reinforced Concrete Pipe (RCP)
      a. Provide manufacturer certification the RCP has been tested in accordance with DMS-7310.
   2. Reinforced Concrete Box Culverts (RCB)
      a. Machine-Made Precast:
         1) Provide manufacturer certification the RCB has been tested in accordance with DMS-7310.
      b. Cast-In-Place:
         1) Test cast-in-place RCB in accordance with Section 03 30 00 and Section 03 00 00.

B. Non-Conforming Materials

1. Reinforced Concrete Pipe (RCP)
   a. Any individual section of pipe may be rejected if the pipe does not conform to the conditions stated in the Annex of DMS-7310, Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification.
   b. Any individual section of pipe may be rejected if the City determines pipe has excessive cracks, fractures, gouges, or any other surface deformations.
2. Reinforced Concrete Box (RCB)
   a. Any individual section of box may be rejected if the City determines the box has excessive cracks, fractures, gouges, or any other surface deformations.
   b. Any individual section of box may be rejected if the following tolerance requirements are not met.
      1) General requirements:
         a) In accordance with permissible variations listed in ASTM C1577
         b) Sides do not vary from perpendicular to the top and bottom by more than 0.5 inch when measure diagonally between opposite interior corners.
      2) Wall and Slab Thicknesses:
         a) Verify all box wall and slab thicknesses match the thicknesses specified in the Drawings.
         b) Occasional deficiencies are allowed when the deficiencies are not greater than 3/16 inch or 5% of the thickness, whichever is greater.
         c) Wall and slab thicknesses greater than specified in the Drawings are acceptable if the jointing is not affected.
      3) Deviations from the above tolerances is not acceptable. Any box found to be non-compliant will be removed and replaced at no cost to the City.

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION [NOT USED]

3.4 INSTALLATION

A. Excavation, Shaping, Bedding, and Backfill

1. Perform excavation, shaping, bedding, and backfill in accordance with Section 33 05 06.
2. Take care when placing and compacting the backfill to avoid any movement of storm water pipe and boxes or damage to the joints.
3. Do not use heavy earth-moving equipment to haul over the pipes or boxes until a minimum of 4 feet of permanent or temporary compacted fill has been placed over the structure unless otherwise specified in the Drawings or permitted in writing.
4. Corrugated Metal Pipe
   a. The City and Contractor to visually inspect the inside periphery of the pipes for local or unequal deformation caused by improper construction methods before adding each new layer of loose backfill material.

b. Continue inspections until a minimum of 24 inches of cover is obtained.
c. Remove and replace any pipe the City considers deformed or non-conforming at no cost to the City.

B. Jacking, Boring, or Tunneling
1. Jacking, boring, or tunneling is not recommended for installing storm sewer pipe or boxes. Prior approval is required before any jacking, boring, or tunneling operation begins.
2. If jacking, boring, or tunneling is required, provide a design based on the specific installation conditions such as the soil conditions, installation methods, anticipated deflection angles, and jacking stresses.
3. Provide design notes and Drawings signed and sealed by a Texas licensed professional Engineer.
4. Additional Reinforced Concrete Box Requirements
a. In accordance with TxDOT Item 476.
b. The box ends must be square and no point should deviate more than 3/8 inch from a plane placed on the end of the box that is perpendicular to the sides.
c. Wall and Slab Thickness:
1) Minimum thickness as specified in the Drawings
2) No greater than 0.5 inches than the thickness specified on the Drawings

C. Pipe Laying
1. General:
a. Where possible, install the pipe so that the top of pipe is below any pavement subgrade, unless otherwise specified in the Drawings.
b. Maintain a minimum 0.5 percent slope unless otherwise shown on the Drawings.
c. Start the laying of pipe on the bedding at the outlet end with the spigot or tongue end pointing downstream.
d. Proceed towards the inlet end with the abutting sections properly matched true to the established lines and grades specified in the Drawings.
e. Fit, match, and lay the pipe to form a smooth and uniform conduit.
f. Lower sections of pipe into the trench without damaging the pipe or disturbing the bedding and the sides of the trench.
g. Carefully clean the ends of the pipe before the pipe is placed.
h. Prevent the earth or bedding material from entering the pipe as it is laid.
2. Reinforced Concrete Pipe
a. General:
1) Cut cross trenches in the foundation to allow the barrel of the pipe to rest firmly on the bedding where bell-an-spigot pipe is used.
2) Cut cross trenches no more than 2 inches larger than the bell ends of the pipe.
3) Lay multiple lines of reinforced concrete pipe with the centerlines of the individual barrels parallel.
4) Use the clear distances between outer surfaces of adjacent pipes shown in Table 6 unless otherwise specified in the Drawings.
5) Use the equivalent diameter from Table 2 or 3 for arch or horizontal elliptical pipe to determine the clear distance requirement in Table 5.
b. Elliptical Pipe:

1) Lay the pipe so the markings for the top or bottom are not more than 5 degrees from the vertical plane through the longitudinal axis of the pipe.
2) Remove and re-lay any pipe that is not in alignment or shows excessive settlement after laying at no cost to the City.

Table 5
Minimum Clear Distance Between RCP

Equivalent Diameter (Inches)	Minimum Clear Distance
18	9 inches
24	11 inches
30	1 foot, 1 inch
36	1 foot, 3 inches
42	1 foot, 5 inches
48	1 foot, 7 inches
54	1 foot, 11 inches
60 to 84 inches	2 feet

D. Corrugated Metal Pipe (CMP)

1. Coat any metal in joints that are not protected by galvanizing or aluminizing with an approved asphalt paint.
2. Use the clear distances between outer surfaces of adjacent pipes shown in Table 6 unless otherwise shown on the Drawings.

Table 6
Minimum Clear Distance Between CMP

Equivalent Diameter (Inches)	Minimum Clear Distance (Inches)
18	1 foot, 2 inches
21	1 foot, 3 inches
24	1 foot, 5 inches

E. Placement of Boxes

1. Where possible, place the box so the top of box is below any pavement subgrade, unless otherwise shown on the Drawings.
2. Maintain a minimum 0.5 percent slope unless otherwise specified in the Drawings.
3. Place the box sections in accordance with the Drawings.
4. Place material to be used between barrels as specified in the Drawings or as directed by the City.
5. Start laying the boxes on the bedding at the outlet end.
6. Proceed toward the inlet end with the abutting sections properly matched true to the established lines and grades specified in the Drawings.
7. Fit, match, and lay the boxes to form a smooth and uniform conduit.
8. Lower the box sections into the trench, for trench installations, without damaging the box or disturbing the bedding and the sides of the trench.
9. Carefully clean the ends of the box before it is placed.

10. Prevent the earth or bedding material from entering the box as it is laid.
11. Remove and re-lay any box section that is not in alignment or shows excessive settlement after laying at no cost to the City.

F. Jointing
   1. Reinforced Concrete Pipe (RCP) and Concrete Box (RCB)
      a. Provide an appropriate rolling device for conveyance through small-size pipe structures.
      b. Allowable joint deflection is one half of the published manufacturer's allowance unless written approval is obtained from the City Engineer.
      c. Joints Sealed with Rubber Gaskets:
         1) Make the joint assembly according to the recommendations of the gasket manufacturer.
         2) Make joints watertight when using rubber gaskets.
         3) Backfill after the joint has been inspected and approved.
         4) Reinforced Concrete Box (RCB)
            a) Box joints for rubber gasketed material may be substituted for tongue and groove joints.
            b) Provide rubber gasket joints for RCB in accordance with the requirements of ASTM C1677.
      d. Joints Using Pre-Formed Flexible Joint Sealants:
         1) Install pre-formed flexible joint sealants in accordance with the manufacturer's recommendations.
         2) Place the joint sealer so no dirt or other deleterious materials encounter the joint sealing material.
         3) Pull or push home the pipe with enough force to properly seal the joint.
         4) Remove any joint material pushed out into the interior of the pipe that would obstruct the flow.
         5) Apply flexible joint sealants to the pipe joints immediately before placing pipe in trench and connecting pipe to previously laid pipe.
         6) Backfill after the joint as been inspected and approved.
   2. Corrugated Metal Pipe (CMP)
      a. General:
         1) Provide field joints that maintain pipe alignment during construction and prevent infiltration of side material during the life of the installation.
         2) Install bands and joints in accordance with manufacturer's recommendations.

G. Connections and Stub Ends
   1. Reinforced Concrete Pipe (RCP)
      a. Make connections of concrete pipe to existing pipes, pipe storm drains, or storm drain appurtenances as specified in the Drawings.
      b. Mortar or concrete the bottom of existing structures if necessary to eliminate any drainage pockets created by the connections with a Type S mortar in accordance with the requirements of ASTM C270.
      c. Repair any damage to the existing structure resulting from making the connections.
      d. Make connections between concrete pipe and corrugated metal pipe with a suitable concrete collar and a minimum thickness of 4 inches.

1) Corrugated metal pipe is not permitted for use within the City's right-of-way unless otherwise specified in the Drawings or herein.
2) Prior to connecting to an existing CMP storm system:
   a) Remove any existing corrugated metal pipe to the City's right-of-way.
   b) Replace with an equivalent sized RCP.

e. Finish stub ends for connections to future work not shown on the Drawings by installing watertight plugs into the free end of the pipe. Plugs are considered subsidiary to the RCP unless a separate bid item is provided.
f. Fill lift holes with concrete, mortar, or precast concrete plugs after the pipe is in place.

2. Reinforced Concrete Box (RCB)
   a. Make connections of boxes to existing boxes, pipes, drains, or drain appurtenances as specified in the Drawings.
   b. Mortar or concrete the bottom of existing structures if necessary to eliminate any drainage pockets created by the connections with a Type S mortar in accordance with the requirements of ASTM C270.
   c. Connect boxes to any required headwalls, wingwalls, safety end treatments, riprap, or other structures as specified in the Drawings or as directed by the City. Connections will be considered subsidiary to the RCB.
   d. Repair any damage to the existing structure resulting from making the connections.
   e. Finish stub ends for connections to future work by installing watertight plugs into the free end of the box. Plugs are considered subsidiary to the RCB unless a separate bid item is provided.
   f. Fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.
3. Corrugated Metal Pipe (CMP)
   a. Make connections of No specifications on this page for formatting purposes. pipe to existing pipe or appurtenances as specified in the Drawings or as directed by the City.
   b. Mortar or concrete the bottom of existing structures if necessary to eliminate any drainage pockets created by the connections with a Type S mortar in accordance with the requirements of ASTM C270.
   c. Insulate portions of aluminum pipe in contact with metal other than aluminum by a coating of material recommended by the manufacturer. Extend coating a minimum of 1 foot beyond the area of contact.
   d. Repair any damage to the existing structure resulting from making the connections.

H. Extending Existing Box Culverts
1. Any curb less than 12 inches will be considered subsidiary to the RCB. Any curb taller than 12 inches will be included under the RCB Extended Curb bid item.
2. Break back and extend existing box culverts in accordance with TxDOT Item 420 and 422.
   a. If extending the existing box culvert is required, provide design notes and Drawings signed and sealed by a Texas licensed professional Engineer.

3.5 REPAIR

A. Make repairs if necessary for reinforced concrete pipe and machine-made precast boxes in accordance with DMS-7310.

B. Reinforced Concrete Box (RCB)

1. Cracks:
    a. Fine cracks on the surface of the section that do not extend to the plan of the nearest reinforcement are acceptable unless the cracks are numerous and extensive. The City will determine if the cracks are considered non-conforming.
    b. Remove and replace any concrete box considered non-conforming at no cost to the City.
2. Excessive damage, honeycomb, or cracking will be subject to structural review by the City.

3.6 RE-INSTALLATION [NOT USED]

3.7 SITE QUALITY CONTROL

A. Site Tests and Inspections
    1. Reinforced Concrete Pipe and Box
        a. Provide access for inspection of the finished pipe at the project site before and during installation.
    2. Stormwater Mains and Laterals
        a. Closed Circuit Television (CCTV) Inspection
            1) Provide a Post-CCTV Inspection in accordance with Section 33 01 30.

B. Non-Conforming Work
    1. Remove and replace any pipe or box damaged by the Contractor during installation at no cost to the City.

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 33 42 23

STORMWATER HEADWALLS, WINGWALLS, AND END TREATMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Headwall
      b. Wingwall (each and square foot)
      c. Pipe culvert end treatment
      d. Box culvert end treatment
      e. RCB extended curb (1 to 5 FT)
   2. Precast items are only permitted when written approval has been provided by the City prior to construction activities starting.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.

1.3 REFERENCES

A. Abbreviations and Acronyms
   1. ET – End Treatment
   2. SET – Safety End Treatment
   3. RCB – Reinforced Concrete Box
   4. RCP – Reinforced Concrete Pipe

B. Definitions
   1. Headwalls
      a. All walls, including wings, at the ends of a single-barrel and multiple-barrel pipe culvert structure.
   2. Wingwall
      a. All walls at the ends of a single-barrel or multiple-barrel box culvert structures.
   3. RCB Curb
      a. Any curb shorter than 12 inches from the top of the box to the top of the curb will be considered subsidiary to the RCB. Any curb taller than 12 inches will be included under RCB Extended Curb.

C. Reference Standards
   1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
   2. American Association of State Highway and Transportation Officials (AASHTO).
   3. American Society for Testing and Materials (ASTM):
      a. ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
      b. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   4. Texas Department of Transportation Standards
      a. DMS-4675 – Cementitious Grouts and Mortars for Miscellaneous Applications.

b. DMS-6100 – Epoxies and Adhesives.
c. DMS-7310 – Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification.

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.
B. All submittals shall be approved by the City prior to purchasing of materials.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Shop Drawings:
1. Headwalls, Wingwalls, End Treatments, and Riprap
a. Provide the following information on the shop drawing submittal:
1) Product type and description
2) Class of concrete
3) Concrete mix design (only for cast-in-place)
4) Connection/jointing material used
5) Manufacturer recommendations for storage, handling, and installation.
2. Product Data
a. Provide a product data sheet for the following:
1) Pipe Runners
2) Mortar, if applicable
3) Epoxy, if applicable
4) Jointing Material
5) Any bonding material
B. Information Submittals:
1. Certificates:
a. Provide the manufacturer's certificate of compliance that their product meets the physical testing requirements of this specification, DMS 7310, and DMS 4675 for the materials referenced which may include, but are not limited to:
1) Concrete mix design and reinforcing (if using precast)
2) Mortar
3) Pipe runners
2. Equipment Submittals:
a. Submittal for all major equipment to include:
1) Equipment name and description
2) Size
3) Intended use

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements
1. Do not place any loads on precast items before design strength has been reached.
2. Do not ship items until design strength requirements have been met.
B. Storage and Handling Requirements
1. Secure and maintain a location to store the material in accordance with Section 01 66 00.
2. Store precast items on a level surface.
C. Markings:
1. Mark all precast items or mitered RCP before shipment from the manufacturer:
a. Name or trademark of manufacturer
b. Product designation (Type and Size)

c. ASTM designation
d. Date of manufacture
e. Designated fabricator's approval stamp

2. Indent markings or paint them on with waterproof paint.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete:
1. Headwalls, Wingwalls, and End Treatments:
a. Class P in accordance with Section 03 00 00 unless otherwise specified in the Drawings.
2. RCB Extended Curb:
a. Class P in accordance with Section 03 00 00 unless otherwise specified in the Drawings.
3. Riprap:
a. Class A in accordance with Section 03 00 00 unless otherwise specified in the Drawings.
4. Precast:
a. Provide the class of concrete required based on the use. Provide machine-made precast or precast items that are supplied by a manufacturer. Formed precast is not permitted by Contractor.
5. Cast-In-Place:
a. Fabricate in accordance with Section 03 30 00.

B. Reinforcement:
1. Provide Grade 60 reinforcing steel in accordance with Section 03 00 00 unless otherwise specified in the Drawings.

C. Mitered RCP:
1. Provide mitered RCP in accordance with Section 33 42 11, the Drawings, and this Section.
2. Mitering or providing a mitered RCP section is considered subsidiary to pertinent items.

D. Riprap:
1. Mitered RCP:
a. Provide riprap as specified in the Drawings around the mitered end of the RCP. Riprap will be considered subsidiary to a mitered end treatment. No separate pay will be given for riprap.
2. Straight or Flared End Treatments:
a. Provide riprap only when specified in the Drawings

E. Pipe Runners
1. Pipe runners are subsidiary to the construction of any end treatment. No separate pay will be given for pipe runners installed on new end treatments.
2. When pipe runners are installed on existing end treatments, the pipe runners will be paid for per each end treatment that pipe runners are installed on. Payment will not be given per each pipe runner.
3. Provide pipe runners in accordance with the following standards:
a. ASTM A1085;
b. ASTM A53, Type E or S, Grade B;
c. ASTM A500, Grade B; or
d. API 5L, Grade X42.

F. Mortar:
1. Provide mortar in accordance with DMS-4675.

G. Jointing Materials

1. Provide jointing materials in accordance with Section 33 42 11.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove portions of existing structures.

B. Remove any existing pipe or box to the nearest joint as needed to construct the proposed headwall, wingwall, or end treatment. Removal of stormwater pipe and box segments to construct the headwall, wingwall, or end treatment will be considered subsidiary to the construction of the stormwater structure.

3.2 CONSTRUCTION

A. Cast-In-Place:
   1. Construct cast-in-place headwalls, wingwalls, and end treatments in accordance with Section 03 00 00, 03 30 00, and this Section.

B. Precast End Treatments
   1. Formed precast end treatments will not be permitted.
   2. Provide cast-in-place or machine-made end treatments.
   3. Provide certification letters stating that the machine-made items were made in accordance with this Section.

C. Construct Riprap in accordance with Section 31 37 00.

D. Construction Joint:
   1. Construct a construction joint when new concrete is placed next to existing concrete or concrete that has already hardened. Roughen and clean concrete surfaces in contact with new construction before placing forms to create a construction joint.
   2. Thoroughly clean the concrete surface of all loose material, dirt, and foreign matter.
   3. Saturate the hardened concrete with water.
   4. Remove all free water and moisten the surface before concrete or bonding grout is placed against it.
   5. Ensure the surface of the existing concrete is in a saturated surface-dry condition just before placing subsequent concrete by performing the following:
      a. Wet the existing concrete by ponding water on the surface for 24 hours before placing subsequent concrete.
      b. Use high-pressure water blasting 15 to 30 minutes before placing the concrete if ponding is not possible to achieve saturated surface-dry conditions.
      c. A saturated surface-dry condition is achieved when the surface remains damp when exposed to sunlight for 15 minutes.
   6. Draw forms tight against the existing concrete to avoid mortar loss and offsets at joints.
   7. Bonding Agents:
      a. Bonding agents are not required unless specified in the Drawings.
      b. If a bonding agent is required, coat the joint surface with bonding mortar, grout, epoxy, or other material.
      c. Mortar:
         1) Place bonding mortar or grout on a surface that is in a saturated surface-dry condition state.
         2) Place the concrete before the bonding mortar or grout dries.
      d. Epoxy:
         1) Provide Type V epoxy per DMS-6100 for bonding fresh concrete to hardened concrete.

2) Place the bonding epoxy on a clean, dry surface, and place the fresh concrete while the epoxy is still tacky.

e. Other Bonding Material:
1) Obtain approval from the City before using an alternative bonding material.
2) Place in accordance with the manufacturer's recommendations.

E. Lifting Holes
1. Provide no more than 4 lifting holes in each section for precast boxes.
2. Lifting holes may be cast-in-place or drilled by manufacturer. Ensure no reinforcing has been cut.
3. Provide lifting holes large enough for adequate lifting devices based on the size and weight of the box section.
4. Use lifting holes no larger than 3 inches in diameter.
5. Repair any spalled areas around lifting holes.
6. Fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.

F. Excavation, Shaping, Bedding, and Backfill
1. Perform excavation, shaping, bedding, and backfill in accordance with Section 33 05 06.
2. Backfill around junction boxes, manholes risers, pipes, and boxes in accordance with Section 33 05 06 and 33 42 11.
3. Take care when placing and compacting the backfill to avoid any movement of the stormwater structures.
4. Bed precast items on foundations of firm and stable material accurately shaped to conform to the bases of the items.

G. Pipe or Box Connections:
1. Make connections to new or existing structures in accordance with the Drawings.

3.3 REPAIR

A. Manufacturer defects or minor accidental damage may be accepted with proper repair.
B. The City will determine if an item can be repaired or will need to be replaced.
C. Replace any non-conforming item at no cost to the City.
D. Repair any items as needed and obtain written acceptance from the City.
1. A repaired item is required to be sound, properly finished, and cured in accordance with this Section and all applicable Sections prior to acceptance.

3.4 RE-INSTALLATION [NOT USED]

3.5 SITE QUALITY CONTROL

A. Non-Conforming Work
1. Precast items may be rejected for not meeting any one of the specification requirements herein.
2. Individual items may be rejected for:
a. fractures or cracks passing through the wall, or
b. surface defects indicating honeycombed or open texture surfaces.
3. Remove and replace rejected items at no cost to the City.

END OF SECTION

SECTION 33 42 30

STORMWATER JUNCTION BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufacturer, material, and installation requirements for stormwater junction boxes.
   2. Precast items are only permitted when written approval has been provided by the City prior to construction activities starting.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

B. No separate measurement and payment is made under this Section. Include cost for work under this Section in the related items in the Site Civil pay item.
   1)

1.3 REFERENCES

A. Abbreviations and Acronyms
   1. JB – Junction Box
   2. PSI – Pounds per Square Inch
   3. RCB – Reinforced Concrete Box
   4. RCP – Reinforced Concrete Pipe

B. Reference Standards
   1. Reference standards cited in this Section refer to the current reference standard published at the time of the latest revision date logged at the end of this Section unless a date is specifically cited.
   2. American Society for Testing and Materials (ASTM):
      a. C478, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
      b. D4101, Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
   3. Texas Department of Transportation (TxDOT) Departmental Material Specifications (DMS):
      a. 4675, Cementitious Grouts and Mortars for Miscellaneous Applications
      b. 6100, Epoxies and Adhesives
      c. 7310, Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by the City prior to purchasing of materials.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Shop Drawings:
   1. Stormwater Junction Boxes and Manhole Risers
      a. Provide the following information on the shop drawing submittal:
         1) Product type and size
         2) Class of concrete
         3) Concrete mix design (only for cast-in-place)
         4) Connection/jointing material used
         5) Manufacturer recommendations for storage, handling, and installation.
   2. Product Data
      a. Provide a material data sheet for review and approval for:
         1) Mortar, if applicable
         2) Epoxy, if applicable
         3) Jointing Material
         4) Any bonding material

B. Information Submittals:
   1. Certificates:
      a. Provide the manufacturer's certificate of compliance that their product meets the physical testing requirements of this Section, DMS 6100, DMS 7310, and DMS 4675 (if applicable) for the applicable materials used.
   2. Equipment Information
      a. Submittal for all major equipment to include:
         1) Equipment name and description
         2) Size
         3) Intended use

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements
   1. Do not place any loads on precast items before design strength has been reached.
   2. Do not ship items until design strength requirements have been met.

B. Storage and Handling Requirements
   1. Secure and maintain a location to store the material in accordance with Section 01 66 00.
   2. Store precast items on a level surface.

C. Markings:
   1. Mark precast boxes with the following information:

a. Name or trademark of manufacturer
b. Product designation
c. ASTM designation
d. Date of manufacture
e. Designated fabricator's approval stamp
f. Designation "SR" for boxes meeting sulfate-resistant concrete plan requirements (when applicable)

2. Indent markings or paint them on with waterproof paint.

1.11 FIELD CONDITIONS [NOT USED]

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 CITY-SUPPLIED PRODUCTS [NOT USED]

2.2 MATERIALS

A. Manufacturers
   1. Inlet Frame & Cover
      a. Provide in accordance with Standard Product List or approved equal.
   2. Substitution requests for other manufacturers or models shall be processed in accordance with Section 01 25 00.

B. Concrete
   1. Cast-In-Place:
      a. Provide Class C in accordance with Section 03 00 00 unless otherwise specified in the Drawings.
   2. Precast:
      a. Provide Class H with a minimum compressive strength of 5,000 PSI in accordance with Section 03 00 00
         1) Provide machine-made precast inlets in accordance with DMS-7310

C. Reinforcement
   1. Provide grade 60 steel reinforcing in accordance with Section 03 00 00.
   2. Provide a minimum of 2 inches of cover on all reinforcing unless otherwise noted.

D. Cast Iron Frame and Cover
   1. Provide a frame and cover marked "Storm Sewer" in accordance with Section 33 05 67.
      a. Provide Pick Slots
      b. Provide a 32-inch diameter frame and cover that provides minimum 30-inch diameter opening

E. Steps:
   1. Provide polypropylene supports and steps at least 12 inches wide in accordance with ASTM D4101 and ASTM C478, Section 16, "Steps and Ladders".

F. Mortar:

1. Provide mortar in accordance with DMS-4675.

G. Epoxy:
   1. Provide Type V epoxy per DMS-6100 for bonding fresh concrete to hardened concrete.
   2. Place the bonding epoxy on a clean, dry surface, and place the fresh concrete while the epoxy is still tacky.

H. Jointing Materials
   1. Provide jointing materials in accordance with Section 33 42 11.

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION [NOT USED]

3.4 INSTALLATION

A. Construct junction boxes and manhole risers in 1 or 2 stages. Use the following steps if constructing in 2 stages:
   1. No separate pay will be given for staging construction of junction boxes and manhole risers.
   2. Stage 1:
      a. Construct the storm drain pipe or box and attach the base of the junction box or manhole riser.
      b. Provide a temporary plug for the exposed end of the storm drain if needed.
      c. Follow all safety requirements for Federal, State, and local requirements when leaving a junction box or manhole riser exposed.
   3. Stage 2:
      a. Excavate to expose the top of the stage 1 construction (if needed) and complete the junction box or manhole riser in accordance with the Drawings and this Section.
      b. Coordinate construction of the junction box or manhole riser top with paving operations.
      c. Finalize construction of subgrade, asphalt base/surface course, or concrete pavement and adjust the top of the junction box or manhole riser as needed to be flush with the final pavement level.
         1) All adjustments to grade of the junction boxes and manhole risers will be considered subsidiary to the construction of the junction box or manhole riser regardless of how many times the top needs to be adjusted due to phasing of the project.
      d. Remove any temporary plugs prior to completion of the junction box or manhole riser.
      e. Furnish and install any frames, grates, rings, and covers.

f. Clean all debris from the walls and bottom of the junction box or reinforced concrete box.

B. Cast-In-Place Junction Boxes and Manhole Risers:
   1. Construct cast-in-place junction boxes and manhole risers in accordance with Section 03 00 00, 03 30 00, and this Section.

C. Precast Junction Boxes and Manhole Risers
   1. Precast junction boxes and manhole risers are only permitted when written approval has been provided by the City prior to construction activities starting.
   2. Formed precast junction boxes and manhole risers will not be permitted.
   3. Provide cast-in-place or machine-made precast junction boxes and manhole risers.
   4. Construct machine-made items in accordance with ASTM C478 and this Section.
   5. Provide certification letters stating the machine-made items were made in accordance with DMS-7310 and ASTM C478 and conform to the product permissible variations and rejection criteria stated in ASTM C478.

D. Steps
   1. Cast-In-Place:
      a. Cast steps into the junction box or manhole riser walls
   2. Precast:
      a. Drill and epoxy or grout steps in place in accordance with manufacturer's recommendations.

E. Lifting Holes
   1. Provide no more than 4 lifting holes in each section for precast boxes.
   2. Lifting holes may be cast-in-place or drilled by manufacturer. Ensure no reinforcing has been cut.
   3. Provide lifting holes large enough for adequate lifting devices based on the size and weight of the box section.
   4. Use lifting holes no larger than 3 inches in diameter.
   5. Repair any spalled areas around lifting holes.
   6. Fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.

F. Excavation, Shaping, Bedding, and Backfill
   1. Perform excavation, shaping, bedding, and backfill in accordance with Section 33 05 06.
   2. Backfill around junction boxes, manholes risers, pipes, and boxes in accordance with Section 33 05 06 and 33 42 11.
   3. Take care when placing and compacting the backfill to avoid any movement or damage to the junction boxes, manhole risers, storm water pipe and boxes, or their joints.
   4. Do not use heavy earth-moving equipment over pipes or boxes until a minimum of 4 feet of permanent or temporary compacted fill has been placed over the structure unless otherwise specified in the Drawings or permitted in writing.

G. Stormwater Junction Box

1. Provide the appropriate sized junction box based on the maximum inside pipe diameter shown in Table 1.
2. For a junction box larger than 8-feet tall or wide, provide a structural design.
3. Connections to Reinforced Concrete Pipe (RCP)
   a. Construct junction boxes before completion of stormwater pipes into or through the junction box.
   b. Neatly cut all stormwater pipes at the inside face of the junction box walls.

Table 1
Junction Box Sizes

Square Junction Box Sizes	Maximum Pipe Inside Diameter
4-foot square	36 inches
5-foot square	42 inches
6-foot square	54 inches
7-foot square	66 inches
8-foot square	72 inches

- Square Junction Box Sizes are given based on a 0-degree skew. If there is a skew entering into the junction box, a larger size may be required.

H. Stormwater Manhole Riser

1. A manhole riser may be used in the following conditions:
   a. Stormwater Junction Boxes:
      1) Use only when specified in the Drawings or by the City. If both of the following conditions are met, a manhole riser may be used in conjunction with the base of a junction box to reduce the surface foot-print.
         a) When the size of a junction box is 6-feet or larger
         b) When the depth of the junction box is greater than 2-feet larger than the outside diameter of the pipe.
   b. Reinforced Concrete Box (RCB) Access:
      1) Provide a manhole riser where access is needed.
2. If a Stormwater Manhole Riser is used in conjunction with a Stormwater Junction Box, the manhole riser will be considered subsidiary to the Stormwater Junction Box.
3. Constructing the Manhole Riser
   a. Provide a 48-inch diameter manhole riser with a flat top. A manhole cone is not needed unless otherwise specified.
   b. Thicken the junction box or RCB section top slab to a minimum of 12 inches when using a manhole riser.
   c. Cast the manhole riser with the RCB box when providing a cast-in-place manhole riser and RCB per the Drawings.
   d. When providing a precast manhole riser and RCB, connect the riser to the junction box base or RCB per the Drawings.
4. Connections to Reinforced Concrete Box (RCB)
   a. For manhole risers that connect directly to the top slab of an RCB, install the manhole riser in conjunction with the placement of the RCB.
   b. For RCB connections to one side of junction box base, install the junction box base before or in conjunction with the placement of the RCB.

c. Backfill the junction box or manhole riser and RCB at the same time.

I. Inverts

1. Shape and route floor inverts passing out or through the junction box base as specified in the Drawings.
2. Shape by adding and shaping mortar or concrete after the base is placed or by placing the required additional material with the base.

J. Frame, Grates, and Covers

1. Provide a 32-inch frame and cover in accordance with Section 33 05 81.
   a. A grated cover will not be permitted unless otherwise specified in the Drawings or approved by the City.

3.5 SITE QUALITY CONTROL

A. When a structure is left open without supervision, provide structurally adequate fencing or cover.

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 33 46 23

MODULAR BURIED STORMWATER STORAGE UNITS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Conditions of the Contract and all Sections of Division 1 are a part of these Sections.

1.02 DESCRIPTION OF WORK

A. Work Included:

1. Provide excavation and base preparation per Engineer's recommendations and/or as shown on drawings, to provide adequate support for project design loads. Provide excavation safety in accordance with OHSA requirements. (See Part II – Products 2. Materials)
2. Provide Soils Report that supports appropriate use of EcoRain Tanks (Infiltration or capture and reuse).
3. Provide EcoRain Tank modular units only, constructed and installed per the manufacturer's instructions furnished under this section. Each unit/section shall have a minimum of two interior plates evenly spaced.

B. Related Work

1. Sub-grade Excavation and Preparation - Under Earthwork Section of drawings and specifications.
2. Sub-surface Drainage Materials - Under Sub-Surface Drainage and Structures Section of drawings and specifications as needed.

1.03 QUALITY ASSURANCE

A. Record discussions of meeting decisions and agreements reached and furnish copy of record to each party attending. Review foreseeable methods and procedures related to installation, including the following:

1. Review preparation and installation steps, coordinating and scheduling required with related work.
2. Review proposed sources of materials.
3. Tour, inspect and discuss condition of sub-grade, drainage structures, and other preparatory work.
4. Review requirements for protecting the EcoRain Tank structure, including restriction of traffic during installation period and for remainder of construction period.
5. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
6. Review installation requirements (soils report, drawings, specifications, manufacturer's recommendations about installation in this submittal) and other contract documents.

7. Review required submittals, both completed and yet to be completed.
8. Review required inspections & testing procedures.
9. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
10. Review safety precautions relating to installation.

B. Installation: Performed only by skilled workers with satisfactory record of performance on pipe, chamber, or pond/landfill construction projects of comparable size and quality.

1.04 SUBMITTALS

A. Submit manufacturer's product data and installation instructions. Submit panels of one EcoRain Tank and one 20-inch x 20-inch section of geotextile fabric for product review. Return reviewed and accepted samples to the Contractor.
B. Submit material specifications for EcoRain Tank, Class 1 non-woven geotextile fabric, Biaxial Geogrid or Ecovoid 2" Cell layer if required, base course, and backfill materials.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect all materials from damage during delivery and store under tarps to protect from sunlight exposure exceeding 5 days.
B. Handle with equipment appropriate to the size (height) of EcoRain Tanks and site conditions, which may include, hand, handcart, forklifts, extension lifts, small cranes, etc.
C. Minimize damage to material. Full pallets require the use of a forklift, unloaded on flat surfaces.
D. Storage should occur on smooth surfaces, free from dirt, mud, and debris.

1.06 PROJECT CONDITIONS

A. All Weather

1. Review installation procedures and coordinate EcoRain Tank work with other work, such as grading, excavation, utilities, construction access, and erosion control.
2. Prevent all non-installation related construction traffic around the EcoRain Tank installation.
3. Either complete adjacent construction prior to the installation of EcoRain Tanks or provide detours for all traffic exceeding load rating for the structure.
4. When installing EcoRain Tanks, take care against damage from other construction traffic when work is in progress.
5. Following completion of backfill, mark structure perimeter with highly visible construction tape, fencing, or other means until all site construction is complete.
6. Protect adjacent work from damage during EcoRain Tank installation.
7. Direct all site stormwater runoff away from the installation area. The installation area shall not receive site runoff until the runoff area is maintained with temporary erosion control device and/or site landscaping is established to completely diminish washing of silts and clays into the installation area.

B. Cold Weather

1. Do not use frozen materials or materials mixed or coated with ice or frost.
2. Do not build on frozen, wet, saturated, or muddy sub-grade.

PART 2 - PRODUCTS

2.01 PRE-APPROVED MANUFACTURER.

A. Manufacturer: EcoRain Tank Systems of America, Inc.
12400 Ventura Boulevard #167
Studio City, CA 91604
1.818.501.0424
contact@ecoraintank.com

B. Contact: Eli Gonzalez
832-427-2411
egonzalez@ecosvs.com

C. Equipment from alternate manufacturers shall not be acceptable unless pre-approved two weeks prior to bid date per Section 01 62 00 Substitutions and Product Options.

2.02 MATERIALS SPECIFICATIONS

A. Minimum requirements for installations subject to repetitive AASHTO H25 wheel loading. When installed in competent soil conditions the AASHTO H25 loading allows a total load of 50,000 lbs as shown in test data. Backfill material, geotextile fabric and Biaxial Geogrid may vary depending upon surface loading conditions, infiltration requirements, soil conditions and soil gradation. Always follow Engineer's requirements to address these concerns.

B. Base Excavation: Shall be smooth soil, level and free of lumps or debris. Compact as required by Soils Engineer. Structural fill material may be used to amend the structural capacity of the soil or six to eight inches of gravel or sand may be used as a structural base as determined by the Soils Engineer. Geogrid and/or ET-1301 or ET-1401 may be required to achieve the minimum saturated bearing capacity in the base soils.

C. Geotextile: Shall be non-woven Class 1, wrapped around all sides, top and bottom of the Tank assembly, with a minimum six-inch joint overlap. (See Geotextile Fabric Specifications Sheet)

D. Geogrid: Where required, use a Biaxial Geogrid (Tensar BX1200, Terragrid B120 or Synteen SF12 or equivalent) or Ecovoid HD 2" Cell (405 psi) layer for structural support. EcoRain Tank Systems recommends using Biaxial Geogrid or a layer of Ecovoid HD 2" Cells in traffic rated installations. Follow Geogrid manufacturers or EcoRain Tank Systems recommendation for Ecovoid HD 2" Cell layers as to placement.

E. EcoRain Tank: Injection moulded recycled polypropylene plastic units, 1.34' wide by 2.23' long and from .79' tall as specified by the Engineer, assembled from flat interlocking panels. Each unit shall have a minimum of two interior panels equally spaced plus two end panels for landscape applications and a minimum of three interior panels equally spaced plus two end panels for vehicle load applications. Assemble units into vertical structures as shown in the plan, maximum

five units tall. (For taller EcoRain Tanks, contact the manufacturer – EcoRain Tank Systems or consult a qualified Geotechnical Engineer.)

F. Bedding Layer: Layer a minimum of two inches of clean sand, gravel materials or a mix of both, free from lumps and debris or any other sharp materials - must be properly compacted as in A. above.

G. Placement: Place the EcoRain Tanks vertically into excavation per manufacturer's recommendations. Abut assembled Tanks in the excavation and wrap in Class 1 non-woven geotextile fabric to create one structure.

H. Pipes: Connect pipes, if any, before backfilling.

I. Filters: All water entering the Tank structure must be filtered, either through a rock/sand/soil profile or if water is directed via pipe, use of a manufactured filter that will not allow any debris to bypass the filter must be installed on all inlet pipes.

J. Side Backfill: Side backfill must be completed before top backfill is started. Fill with clean sand or gravel (¾" minus or less – no limestone) materials or a mix of both, free from lumps and debris or any other sharp materials to backfill along the sides of the Tank. During compaction with powered mechanical compactor, cover the side of the Tank with a sheet of plywood to protect fabric and Tank from the compactor. Move the plywood sheet as the compactor moves. Compact side fill in lifts that do not exceed 12 inches as required by a Soils Engineer, to provide a settlement free surface of the sides of the structure. Verify by meter during progression.

K. Top Backfill for Parking Lots and Heavy Load Applications:

    1. Use a minimum of five ET-1507 Small Plates in each unit of Double, Triple, Triple + Half, Quad, Quad + Half, and Pent Tanks for parking lot applications.
    2. Use minimum 24 inches fill material as required by approving agency for parking lots or driveways (please contact us if project calls for less or more depth – specification will change depending on design and may include the use of additional Small Plates instead of traffic load five Small Plates per unit and/or Ecovoid HD Cells). All fill materials shall be compacted for parking lots or heavy load application as specified by a Soils Engineer. The use of an Ecovoid HD 2" Cell layer or Biaxial Geogrid layer between the top of the Tank structure and finished grade is recommended – follow manufacturer recommendation for placement.
    3. After the side backfill is fully in place and compacted, backfill top in lifts of 12-inch depths and compact each layer, including self-compacting fill, with low-pressure tire or track vehicles, walk-behind vibratory plate compactors, or approved equipment. Do not use vibratory rollers at any time, even after full backfill. (See Equipment Sheet for approved compactors.)

4. Top backfill will not exceed four feet in depth without prior review and written approval from the manufacturer.
    5. Do not operate AASHTO H-25 load rated equipment over the EcoRain Tank structure until a properly compacted approved minimum cover and pavement is in place. (See Part III - Execution, 3. Installation, F.)

L. Top Backfill for Non-Vehicle Load Applications:

1. Use 18-inch minimum of porous top fill to allow infiltration into the EcoRain Tanks as specified by the Soils Engineer for non-vehicle load bearing swales and landscapes above the EcoRain Tanks. Please contact us if project calls for less than 18-inches or more than 48-inches depth – specification will change depending on design and may include the use of additional Small Plates and/or Cells.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine prepared excavation and conditions for level smoothness to within ½" or as specified, and compaction. Correct unsatisfactory conditions before start of EcoRain® Tank installation. Check for presence of high-water table, which must be always kept at levels below the bottom of the EcoRain Tank structure (a layer of Ecovoid HD 2" Cells can be used as the underdrain medium - contact manufacturer for details).
B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact the Engineer for resolution. Saturated sub-base soils shall have a minimum allowable bearing value of 35 psi.

3.02 PREPARATION

A. Keep all construction traffic away from the limits of excavation until the project is complete and final surface materials are in place by delineating with high visibility tape or other means.
B. Following OSHA requirements, excavate site to proper depth, accounting for 2-inch bedding and specified height of EcoRain Tank and specified depth of cover over EcoRain Tanks. Smooth the subgrade, free of lumps, roots, & debris.
C. If it rains after excavation, but before installation of Tanks, the base must be dry and levelled before installation begins.
D. Place a minimum 2-inch-thick layer of clean sand or gravel materials, free from lumps and debris or any other sharp materials over prepared sub-grade. Screed a 2-inch-thick layer to ensure level surface to within ½" or as shown on plan.
E. Where an impervious liner is specified to harvest rainwater or prevent groundwater intrusion, install in accordance with the plans, and Engineer's or other professional's specifications. As recommended by the liner manufacturer, place a layer of geotextile fabric in the bottom and sides of the excavation to protect the outside of the liner. Place and unfold the liner on top of the geotextile fabric. Chalk or paint lines for layout in the excavation are recommended.
F. Inside the liner, place and stretch smooth Class 1 non-woven geotextile fabric over the entire base area and sides of the excavation in strips with enough to encase the completed EcoRain Tank structure. Create minimum 6-inch joint overlaps.
G. Assemble EcoRain Tank units as indicated in assembly directions provided by manufacturer or distributor. Assembled unit panels shall be firmly interlocked. Place tall elevation on the vertical plane. Place narrower side in the horizontal plane. Each unit shall have a minimum of two

interior Small Plates in landscape/non-traffic areas and three interior Small Plates in vehicle traffic areas. Do not use cracked or broken plates – replace with intact plates. Zip ties may be used to secure vertically stacked units. Zip tie ends must be turned inward into the Tanks to avoid tears to the Geotextile material wrap.

H. Inspection Ports are required. Install in the outside perimeter of the tank structure where a 6 - 12" diameter pipe can be angled downward to a partial or full channel (See ET-1210 & ET-1210A).

3.03 INSTALLATION OF ECORAIN TANKS

A. Place assembled interlocked vertical Tank units in position on top of the Geotextile fabric in the excavation. Chalk lines for layout in the excavation are recommended. Abut vertically stacked Tank units' side by side. Contractor may use EcoRain Tank clips to connect Tanks. Keep geotextile fabric on bottom, sides, and top clear of construction activity, and ensure adequate length is available to wrap the completed Tank size. Orient all Tanks so that the Large Plate is on the perimeter of the installation. This means that two ends of the structure will have a row of Tanks placed perpendicular to all the other rows. See ET-1211 drawing of Typical EcoRain Tank Assembly Layout. If not possible to place Tanks perpendicular on the ends, reinforce ends with either EcoRain 1" or Ecovoid HD 2" Cell layers. In structures that are using EcoRain Triple, Triple + Half, Quad, Quad + Half, or Pent Tanks, place perpendicular rows between every six rows or less. See EcoRain drawing ET-1212B.

B. Identify locations of filters and inlet pipes, outlet pipes, inspection ports, and/or cleanout portals, if any. Secure pipe connections to geotextile fabric using stainless steel pipe clamps, zip ties, and/or fully securing with HDPE Tape so that no soil can enter the structure. Connect pipe as follows: For side mounted inlet/outlet pipes exceeding six inches in diameter, place a layer of Ecovoid HD 2" Cells vertically next to the Large Plate side only, where the pipe aligns with the Tank. In a second layer of Ecovoid HD 2" Cells, cut a hole the size of the pipe, place this layer next to the first layer, pull the geotextile fabric over the layers, and mark and cut an X in the fabric at the pipe opening in the Ecovoid HD 2" Cell layer. Cut a fabric collar with an X cut for the pipe, pull over end of pipe. Then place the pipe end in the cut layer of Ecovoid HD 2" Cells, push the collar into the fabric layer surrounding the Tanks, pull the ends of the fabric over the pipe and secure so that no soil/sand can enter the Tank. (See ER-1216 for Pipe Collar detail). Support pipe in trenches and during backfill operations to prevent damage to pipe or liner if used. Connect pipes prior to backfilling. See EcoRain drawing ET-1207 or ET-1215 for pipe connections. Proceed as outlined in C. below.

C. When the EcoRain Tank modular structure is fully in place, stretch geotextile fabric up the sides and over the top of the structure, smooth wrinkles in the fabric, overlap seams by at least six inches and seal joints, fully securing with HDPE Tape so that no soil can enter the structure. (See ET-1216 for Pipe Collar detail.) Trim and fold excess geotextile fabric at corners to lay flat against sides of structure, securing folds and seams with HDPE Tape. If an impermeable liner is installed, place a layer of protective fabric in the pit before laying out the liner. Follow the Liner

manufacturer's recommended instructions to secure the liner around the structure. Follow the Liner manufacturer's instructions to cut and seal holes in the liner.

D. Install 2-foot lengths of metallic underground locator tape on each top corner of the Tank structure.
E. Place backfill carefully to avoid shoving or damage to tanks and geotextile fabric. Excavator equipment shall remain clear of the excavation. Backfill on opposite sides of the structure at the same time, compacting material in 8 to 12-inch lifts. Keep compactor equipment clear of tank structure and cover the side of the tank with a sheet of plywood to protect the fabric, tank (and liner if used) from the compactor. This plywood sheet must be moved as the compactor moves, as it acts as a temporary cover to protect the side of the structure from the compactor to avoid any possible damage to the side of the Tanks, fabric, and liner.
F. After sides are completely backfilled, check for broken plates on the top of the structure, if any they MUST be replaced. Then place backfill material over top of structure - material shall not be dropped vertically on the tank from a distance greater than one foot. Place a minimum of 12 inches of cover before driving equipment on top of structure to protect the Tank and fabric. Compact in 8 to 12-inch lifts as specified by a Soils Engineer, using low-pressure tire or track vehicles, light-weight vibratory plate compactors, walk behind rollers or approved equipment (Do not use equipment exceeding 6,000 lbs.).
G. Equipment shall not make turning movements on top of the Tank.
H. Place a layer of Ecovoid HD 2" Cells or Biaxial Geogrid at least 12 inches below finished grade covering entire excavation (top of Tank plus 3-foot overlap of the structure, pinning the edges into solid ground). Provide at least 12 inches compacted fill (as specified by the Engineer) under Biaxial Geogrid/Cells if used. Place additional cover and compact with low-pressure tire or track vehicles, lightweight vibratory plates, walk-behind rollers, or approved equipment.
I. Do not use vibratory rolling compactors at any time.
J. Place surfacing materials, such as groundcovers or shrubs, or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.

3.04 SITE CLEANING

A. Perform cleaning during the installation of work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 34 71 13

Traffic Control

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Installation of Traffic Control Devices and preparation of Traffic Control Plans
2. The Contractor shall follow the construction procedure and maintenance of traffic as shown on the Drawings, unless a more workable plan is agreed to by the Engineer and the City's Transportation Department, prior to or during the prosecution of the work.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Installation of Traffic Control Devices

a. Measurement

2. Measurement for Traffic Control Devices shall be as a lump sum for the Project duration.

b. Payment

3. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" shall be paid for at the unit price bid for "Traffic Control".

c. The price bid shall include:

1) Traffic Control implementation
2) Installation
3) Maintenance
4) Adjustments
5) Replacements
6) Removal

2. Portable Message Signs

a. Measurement

1) Measurement for this Item shall be per week for the duration of use.

b. Payment

1) The work performed and materials furnished in accordance to this Item and measured as provided under "Measurement" shall be paid for at the unit price bid per week for "Portable Message Sign" rental.

c. The price bid shall include:

1) Delivery of Portable Message Sign to Site
2) Message updating
3) Sign movement throughout construction
4) Return of the Portable Message Sign post-construction

3. Preparation of Traffic Control Plan Details

a. Measurement

1) Measurement for this Item be per each Traffic Control Detail prepared.

b. Payment

1) The work performed and materials furnished in accordance with this Item shall be paid for at the unit price bid per each “Traffic Control Detail” prepared.

c. The price bid shall include:

1) If different from the plan sheets, preparing the Traffic Control Plan Details
2) Adherence to Owner and Manual on Uniform Traffic Control Devices (MUTCD)
3) Incorporation of Owner comments

1.2 REFERENCES

A. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
2. Manual on Uniform Traffic Control Devices (MUTCD).
3. Texas Department of Transportation Standard Specifications

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Contact Owner a minimum of 48 hours prior to implementing Traffic Control within 500 feet of a traffic signal.

B. Sequencing

1. Any deviations to the Traffic Control Plan included in the Drawings must be first approved by the Owner and design Engineer before implementation.

1.4 SUBMITTALS

A. Provide the Owner with a current list of qualified flaggers before beginning flagging activities. Use only flaggers on the qualified list.

B. Design Engineer will furnish standard details for Traffic Control.

PART 2 - PRODUCTS

2.1 ASSEMBLIES AND MATERIALS

A. Description

1. Regulatory Requirements

a. Provide Traffic Control Devices that conform to details shown on the Drawings, the MUTCD, and TxDOT’s Work Zone Traffic Control Device List.

2.2 CONSTRUCTION TRAFFIC CONTROL DEVICES

A. Description

1. The work covered by this Section consists of furnishing, erecting, maintaining, relocating, and removing traffic control devices in accordance with the Drawings, Specifications, MUTCD, TxDOT, or as directed by the Engineer. The MUTCD referred to in this provision shall be the current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways, as prepared by the National Advisory Committee on Uniform Traffic Control Devices, including all standard documents referred to in the second paragraph of Section 1A-7 of the MUTCD. The current edition shall be the edition current on the date of advertisement for the Project. All traffic control devices furnished by the Contractor shall remain the property of the Contractor, unless otherwise required by the Contract. Traffic control devices shall include, but not be limited to signs, nonmetallic drums, barricades, cones, delineators, temporary guardrail, temporary pavement marking, raised reflective pavement markers, flaggers and pilot vehicles, as required.

B. Materials – General

1. Unless otherwise required, materials used in the fabrication and installation of construction traffic control devices shall be in accordance with the applicable provision of the MUTCD. When traffic control devices are no longer required for traffic handling in the initial phase of construction requiring their use, they may be reused at various locations throughout the project provided the device is not defaced, is structurally sound, clean, and otherwise conforms to the above requirements.
2. Traffic control devices which do not meet the requirements of this Section shall not be used; and, when during the life of a project, a device ceases to meet the requirements of this Section it shall be promptly removed and replaced with a conforming device at no additional compensation. The Engineer shall have the authority to determine the acceptability of the traffic control devices.
3. Construction Methods - General - Traffic control devices shall be installed at the inception of construction operations, and shall be properly maintained, relocated as necessary, cleaned, and operated during the time they are in use. They shall remain in place only as long as they are needed and shall be immediately removed thereafter. Where operations are performed in stages, only those devices that apply to the conditions present shall be left in place.
4. The location, legends, sheeting, dimensions, number of supports, and horizontal and vertical placement of warning signs, barricades, and other traffic control devices shall be as required by the Drawings, the MUTCD, TxDOT, or as directed by the Engineer. The Contractor may submit for the Engineer's consideration a method for handling traffic other than as shown on the Drawings. The alternate traffic handling plans shall not be used until they are approved by the Engineer in writing. During periods when not warranted, warning signs and other devices shall be removed from the work area, covered with specified material, or otherwise positioned so they do not convey their message to the traveling public. If covered, the covering material shall be exterior plywood and shall cover the entire face of the sign panel. The covering material shall be installed in such a manner that the sign panel will not be defaced. Covering material shall be maintained in a neat and workmanlike manner during its use.
5. Weeds, brush, trees, construction materials, equipment, etc., shall not be allowed to obscure any traffic control device in use.
6. If cones are used for delineation at night, each cone shall have any appropriate white reflectorized cone collar as detailed on the Drawings, or as directed by the Engineer.
7. Competent and properly trained flaggers, properly attired and equipped, shall be provided as shown on the Drawings, when directed by the Engineer, or when the Contractor deems it necessary to safely handle traffic through the construction area.

8. The Contractor shall assume full responsibility for the continuous and expeditious maintenance of all construction warning signs, barricades, and other traffic control devices. Maintenance shall include repair and replacement of traffic control devices which, in the opinion of the Engineer, are damaged by traffic or other means, or deteriorated beyond effectiveness. Conditions covered under maintenance shall include but not be limited to replacement due to loss of reflectivity; replacement of broken supports; plumbing of leaning signs; cleaning of dirty signs, barricades, and other devices; repair of defaced sheeting and legend; and replacement of stolen or vandalized items. All items used for traffic control shall be maintained in a satisfactory condition. Failure to maintain all traffic control devices in a satisfactory condition may be cause for suspension of construction operations until proper traffic control is re-established.
9. The Contractor shall continuously review and maintain all traffic handling measures to assure that adequate provisions have been made for the safety of the public and workers.

2.3 STATIONARY CONSTRUCTION SIGNS

A. Description

1. The work covered by this Section consists of furnishing, erecting, relocating, maintaining, and removing stationary signs necessary for controlling traffic.

B. Materials

1. Reflective sheeting shall be used on all sign facing and shall meet the requirements of AASHTO M268. The reflective sheeting shall be enclosed lens (Engineers grade) sheeting and shall have a smooth, sealed outer surface which will display the same color both day and night. The reflective sheeting on each sign shall have a smooth appearance. The reflective sheeting shall be applied in a workmanlike manner so that there are no bubbles or wrinkles in the material.
2. The Contractor shall furnish a material certification in accordance with the TxDOT Standard Specifications for all new and used reflective sheeting as required by the Engineer.

C. Construction Methods

1. All work shall be in accordance with requirements of Section 2.2.

2.4 TYPE III BARRICADES

A. Description

1. The work covered by this Section consists of furnishing, erecting, maintaining, and removing Type III Barricades.

B. Construction Methods

1. All work shall be in accordance with requirements of Section 2.2.

2.5 PORTABLE TEMPORARY TRAFFIC CONTROL DEVICES

A. Description

1. The work covered by this Section consists of furnishing erecting, relocating, maintaining, and removing portable temporary traffic control devices necessary for controlling traffic. Portable temporary traffic control devices shall include but not be limited to portable signs, non-metallic drums, barricades, cones, delineators, flaggers, pilot vehicles, and any other traffic control device not covered by any other Sections included in this Contract.

B. Materials

1. Portable Signs - Reflective sheeting shall be used on all sign facing and shall meet the requirement of AASHTO M268. The reflective sheeting shall be enclosed lens (Engineers grade) sheeting and shall have a smooth, sealed outer surface which will display the same color both day and night. The reflective sheeting on each sign shall have a smooth appearance. The reflective sheeting shall be applied in a workmanlike manner so that there are no bubbles or wrinkles in the material.
2. The Contractor shall furnish a material certification in accordance with the TxDOT Standard Specifications for all new and used reflective sheeting as required by the Engineer.
3. Non-Metallic Drums - The drums shall be made of plastic impact resistant material. The drums shall have a two-piece, breakaway design that will maintain its integrity upon impact throughout a temperature range of -20□F to 125□F. Upon impact the upper portion of the drum shall deform and breakaway from the base, minimizing damage to drums or vehicles. The base and ballast shall remain in position and vehicle shall easily pass over it.
4. The drums shall be designed to have two TYPE "A" or "IC" light wells located on the top surface of the drums. The drums shall be designed with a top to completely seal the drums to prevent water from accumulating and freezing in the bottom of the drums. The base shall be designed to accommodate a sandbag of 40 lbs. to 60 lbs. A sandbag with 50 lbs. of sand shall be supplied with each drum.
5. The drums shall have an assembled minimum height of 36", a minimum outside base diameter of 21", and a combined minimum weight of 12 lbs.
6. The Contractor shall be required to furnish the Engineer a sample drum and its specifications for approval prior to the delivery of drums of the project.
7. The markings on drums shall be horizontal, circumferential, orange and white stripes six to eight inches wide, covering entire outside. The entire area of orange and white shall be reflectorized with the enclosed lens (Engineers grade) sheeting, except for the corrugation area where a 2" non-reflectorized band will be allowed. There shall be at least two orange and two white stripes on each drum. Reflectorized material shall have a smooth, sealed outer surface which will display the same approximate color day and night. The reflective sheeting shall meet the requirement of AASHTO M268.
8. Construction Methods - All work shall be in accordance with the requirements of Section 2.2.

2.6 FLASHING ARROW PANELS

1. Description - The work covered by this Section consists of furnishing, maintaining, moving, and relocating flashing arrow panels mounted on a trailer, truck, or other mobile unit, as shown on the Drawings.
2. Materials - The flashing arrow panels shall meet the requirements of the MUTCD (Section 6E) for a Type A panel.
3. Construction Methods - All work shall be in accordance with the requirements of Section 2.2.
4. During periods of times that traffic is shifted from its normal pattern, a mobile flashing arrow panel shall be used at locations shown on the plans or at locations directed by the Engineer.

2.7 CHANGEABLE MESSAGE SIGNS

1. Description - The work covered by this Section consists of furnishing, installing, maintaining, moving, relocating and removing changeable message signs, as shown on the Drawings.
2. Materials - Use Changeable Message Signs that have been evaluated by NTPEP. Use Changeable Message Signs that are on the TXDOT's Approved Products List and are traffic-qualified by the Work Zone Traffic Control Unit.

3. Construction Methods - Mount all changeable message signs on a trailer, or truck, as specified on the Drawings, designed to adequately support the message board in a level position. Align and sight the changeable message sign to provide optimal driver visibility. The Contractor's sign operator shall adjust flash rate so that a minimum of two complete sign panels can be displayed and legible to a driver while approaching the sign at the posted speed.
4. Relocate the units for the various stages of construction as shown in the Drawings, or as needed to adequately inform the motorists.
5. Provide an experienced operator for the changeable message sign during periods of operation to ensure that the messages displayed on the sign panel are in accordance with the Drawings and in accordance with message content guidelines. Ensure that the message sign is illuminated properly to meet the existing light conditions, and that all adjustments for operation of the sign are made as needed to properly guide motorists.
6. Expedite repairs due to failure, malfunction, or damage to a changeable message sign. Furnish another changeable message sign (approved by the Engineer and at no additional cost) during the repair time. Repair and/or replace changeable message sign immediately; otherwise, suspend all construction activities requiring the use of the sign until the sign is restored to operation.
7. Maintenance - Perform all maintenance operations recommended by the manufacturer of the sign. Include the periodic cleaning of the sign face and associated solar panels in maintenance operations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions

1. Protect existing traffic signal equipment.
2. The Contractor shall move any existing street signs and markers and route markers out of the construction limits of the project and install the street signs and markers and route markers so that they will be visible to the traveling public if there is sufficient right of way for these signs and markers outside of the construction limits.
3. Near the completion of the project and when so directed by the Engineer, the Contractor shall move the signs and markers and install them in their proper location in regard to the finished pavement of the project.
4. Any signs or markers which cannot be relocated due to lack of right-of-way, or any signs and markers which will no longer be applicable after the construction of the project, shall be stockpiled at locations directed by the Engineer for removal by others.
5. The Contractor shall be responsible for any damage to any street signs and markers or route markers during the above described operations.
6. No direct payment will be made for relocating, reinstalling, and/or stockpiling the street signs and markers and route markers as such work will be considered incidental.

3.2 INSTALLATION

A. Follow the Traffic Control Plan (TCP) and install Traffic Control Devices as shown on the Drawings and as directed.

B. Install Traffic Control Devices straight and plumb.

C. Do not make changes to the location of any device or implement any other changes to the Traffic Control Plan without the approval of the Engineer.

1. Minor adjustments to meet field constructability and visibility are allowed.

D. Maintain Traffic Control Devices by taking corrective action as soon as possible.

1. Corrective action includes but is not limited to cleaning, replacing, straightening, covering, or removing Devices.
2. Maintain the Devices such that they are properly positioned, spaced, and legible, and that retroreflective characteristics meet requirements during darkness and rain.

E. If the Inspector discovers that the Contractor has failed to comply with applicable federal and state laws (by failing to furnish the necessary flagmen, warning devices, barricades, lights, signs, or other precautionary measures for the protection of persons or property), the Inspector may order such additional precautionary measures be taken to protect persons and property.

F. Subject to the approval of the Inspector, portions of this Project, which are not affected by or in conflict with the proposed method of handling traffic or utility adjustments, can be constructed during any phase.

G. Barricades and signs shall be placed in such a manner as to not interfere with the sight distance of drivers entering the highway from driveways or side streets.

H. To facilitate shifting, barricades and signs used in lane closures or traffic staging may be erected and mounted on portable supports.

1. The support design is subject to the approval of the Engineer.

I. Lane closures shall be in accordance with the approved Traffic Control Plans.

J. If at any time the existing traffic signals become inoperable as a result of construction operations, the Contractor shall provide portable stop signs with 2 orange flags, as approved by the Engineer, to be used for Traffic Control.

K. Flaggers

1. Provide a Contractor representative who has been certified as a flagging instructor through courses offered by the American Traffic Safety Services Association, the National Safety Council, or other approved organizations.

a. Provide the certificate indicating course completion when requested.
b. This representative is responsible for training and assuring that all flaggers are qualified to perform flagging duties.

2. A qualified flagger must be independently certified by 1 of the organizations listed above or trained by the Contractor's certified flagging instructor.
3. Flaggers must be courteous and able to effectively communicate with the public.
4. When directing traffic, flaggers must use standard attire, flags, signs, and signals and follow the flagging procedures set forth in the TMUTCD.
5. Provide and maintain flaggers at such points and for such periods of time as may be required to provide for the safety and convenience of public travel and Contractor's personnel, and as shown on the Drawings or as directed by the Engineer.

a. These flaggers shall be located at each end of the lane closure.

L. Removal

1. Upon completion of Work, remove from the Site all barricades, signs, cones, lights and other Traffic Control Devices used for work-zone traffic handling in a timely manner, unless otherwise shown on the Drawings.

END OF SECTION

NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.

SECTION 40 05 06
Expansion Joints and Couplings

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Furnish all labor, materials, equipment, and incidentals required to completely install and put into service expansion joints and couplings, as specified herein and shown on the drawings.

1.02 QUALITY ASSURANCE:

A. References:

1. ASTM A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel

2. ASTM A285 - Standard Specification for Pressure Vessel Plates, Carbon Steel Low and Intermediate Tensile Strength

3. AWWA 219 - Bolted, Sleeve-Type Couplings for Plain End Pipe

4. ANSI/NSF Standard 61 - Drinking Water System Components

1.03 SUBMITTALS:

A. Submittals required after award of contract and prior to installation:

1. Technical bulletins and brochures on expansion joints and couplings.

1.04 SHIPPING INSTRUCTIONS:

A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

B. All equipment and parts must be properly protected against any damage during a prolonged period at the site.

C. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

D. Storage and Protection: Take special care to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, preventing any deformation.

1.05 WARRANTY:

A. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the unit(s) restored to service at no expense to the Owner.

PART 2 PRODUCTS

2.01 EXPANSION JOINTS:

A. Expansion joints shall meet or exceed the following design criteria:

1. Working pressure = 150 psi
2. Test pressure = 225 psi
3. Coating requirement = fusion bonded epoxy powder coating, or equal
4. Expansion length shall range from 5 to 10-inches
5. Slip pipe shall be stainless steel

B. The expansion joint shall be tied to the line and supported as shown on the plans.

C. Provide slip pipe, limit rods, gland bolts, washers and nuts and install according to the manufacturer's recommendations.

D. Fusion bonded epoxy coatings, or approved equal are required where specified. Final coatings shall be field applied as required by the painting specifications.

2.02 STEEL COUPLINGS:

A. Bolted steel couplings shall meet or exceed the following design criteria:

1. Working pressure = 150 psi
2. Test pressure = 225 psi
3. Coating requirement = fusion bonded epoxy powder coating, or equal

4. Sleeve length = 14-inches (unless specified)

5. Steel couplings shall be manufactured by Smith-Blair

B. Provide control rods, control rod plates, washers and bolts and install according to the plans and manufacturer's recommendations. Anchor studs are not allowed for restraint.

C. Apply paint to steel couplings as required for adjoining pipe.

D. Fusion bonded epoxy coatings or approved equal are required where specified. Final coatings shall be field applied as required by the painting specifications.

2.03 FLANGE COUPLING ADAPTERS:

A. Flange coupling adapters shall meet or exceed the following design criteria:

1. Working pressure = 150 psi

2. Test pressure = 225 psi

3. Coating requirement = fusion bonded epoxy powder coating with an average thickness of 12 mils

4. Bolts and nuts shall be type 304 stainless steel

5. Gaskets shall be Grade 30 standard

6. Body shall be ductile iron ASTM A536

7. Flanges shall be AWWA C207 class D, ANSI B16.1 class 125 drilling

B. Flange coupling adapters shall be Smith–Blair Series 913 or approved equal.

C. Fusion bonded epoxy coatings, or approved equal are required where specified. Final coatings shall be field applied as required by the painting specifications.

PART 3 EXECUTION

3.01. All expansion joints and couplings shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings.

3.02. Testing: All expansion joints and couplings shall be pressure tested as a part of the pipe.

END OF SECTION

SECTION 40 05 62
Plug Valves

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Furnish all labor, materials, equipment and incidentals required to install and put into operation, plug valves as specified herein and shown on the drawings.

1.02 QUALITY ASSURANCE:

A. References:

AWWA C517 Resilient-Seated Cast-Iron Eccentric Plug Valves

1.03 SUBMITTALS:

A. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the unit(s) restored to service at no expense to the Owner. Warranty shall be for a period of two years and begin on the same date as the maintenance bond.

PART 2 PRODUCTS

2.01 PLUG VALVES:

A. Requirements

The contractor shall furnish and install plug valves as manufactured by De Zurik Corporation or approved equal. Plug valves shall be manufactured in accordance with AWWA C517 and shall be of the 1/4 turn, eccentric non-lubricated type, serviceable under full line pressure, and capable of sealing in both directions at the rated pressure. Plug valves shall have a minimum port area of 80% of the nominal pipe size.

B. Materials

The valve body shall be of cast iron, 30,000 psi tensile strength, with added nickel and chromium, ASTM A126, Class B, 175 psi rating. The valve plug shall be cast iron conforming to ASTM A126, Class B, with neoprene resilient facing. The valve seating design shall be resilient and of the continuous interface type having consistent opening/closing torques, and shall be non-jamming in the closed position. Closure shall be accomplished by means of an offset plug design with a resilient seating face that achieves full 360-degree seating contact. Valves shall be of the bolted bonnet design.

The resilient faced plug shall be replaceable without removing the valve body from the line. The valve body seating area shall be corrosive resistant by a welded-in overlay of high nickel content. Sprayed or plated seating surfaces will not be acceptable. Valves shall have permanently lubricated Type 316 stainless steel bearings on the upper and lower plug stem journal. Bearings shall be replaceable. Packing shall be Buna N (Vee Type). Valves shall be designed such that they can be repacked without removing the bonnet. All exposed nuts, bolts, springs, and washers shall be zinc plated, except exposed hardware for submerged valves and valves in the wet well that shall be of stainless steel. Valves shall be flanged.

C. Actuators

Plug valves shall be equipped with worm gear actuators. All gearing shall be enclosed suitable for running in oil with seals provided on all shafts to prevent entry of dirt and water into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze or stainless steel bearing bushings. Actuator shall clearly indicate valve position and an adjustable stop shall be provided. Construction of actuator housing shall be semi-steel. Hardware on actuators shall be of the same materials as the valves.

D. Plug valves located above ground shall be furnished with a hand wheel for operation.

E. Plug valves in buried service shall be provided with a polyethylene coating.

F. Plug valves for buried service shall be furnished with a square 2” operating nut. The valve box shall be Tyler Pipe 6850 series or approved equal.

G. Installation

Plug valves shall be installed such that the direction of flow through the valve is in accordance with the manufacturer’s recommendations.

PART 3 EXECUTION

3.01 GENERAL:

A. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.

B. The contractor shall provide a supervisor at the work site during all construction operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

C. The contractor and all workmen employed by him shall conduct all operations in a clean and sanitary manner and in conformance with all aspects of the contract documents.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 40 05 65
Check Valves

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Finish all labor, materials, equipment and incidentals required to completely install and put into operation, check valves as specified herein and shown on the drawings.

1.02 SUBMITTALS:

A. Contractor shall submit manufacturer's technical information on all valves and materials of construction in accordance with Section 01 33 23.

1.03 WARRANTY:

The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced, and the unit(s) restored to service at no expense to the Owner.

PART 2 PRODUCTS

2.01 CHECK VALVES:

A. The contractor shall furnish and install swing check valves as manufactured by Val-Matic Valve, DeZurik APCO, and Mfg. Corp. or approved equal.

B. Check Valve body shall be ductile iron ASTM A536 Grade 65-45-12 and have a Buna-N (NBR), ASTM D 2000-BG disc.

C. Nuts, Bolts, and Studs shall be Type 316 Stainless Steel.

D. The check valves shall work without damage to the check valve over the entire range of operating conditions. Slamming shut of the check valve will not be allowed. If slamming occurs the contractor shall adjust the valve accordingly.

E. The valve disc shall be of one-piece construction, precision molded with an integral o-ring type sealing surface and contain alloy steel and nylon reinforcement in the flexible hinge area.

F. The valve body shall have full flow equal to nominal pipe diameter at all points through the valve. The seating surface shall be on a 45° angle to minimize disc travel. The top access point shall be full size, allowing removal of the disc without removing the valve

from the pipeline. The access cover shall be domed in shape, to allow the disc to be fully operational in lines containing high solids content.

G. Backflow capabilities shall be available by means of a screw type backflow actuator. The actuator shall be factory installed.

H. The check valve shall include a position indicator to clearly identify the valve's disc position. The indicator shall be factory installed.

H. The exterior of the valve shall be coated with an approved fusion bonded epoxy coating.

I. The valve shall have an interior protective portland cement mortar lining in conformance with ANSI/AWWA C104/A21.4.

J. The valve shall be cycle tested 1,000,000 times with no signs of wear or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures. The test results shall be independently certified.

K. Materials shall be certified to the following A.S.T.M. specifications:

Body & cover	Ductile iron	ASTM A536 Grade 65-45-12
Disc	Buna-N (NBR)	ASTM D 2000-B6
Interior Coating	Fusion Bonded Epoxy	ANSI/NSF 61 approved
Exterior Coating	Fusion Bonded Epoxy	ANSI/NSF 61 approved
		Coatings per Sec. 09905

PART 3 EXECUTION

3.01 GENERAL:

A. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.

B. The Contractor shall provide a supervisor at the work site during all construction operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

C. The Contractor and all workmen employed by him shall conduct all operations in a clean and sanitary manner and in conformance with all aspects of the contract documents.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 40 05 78

Air Release Valves for Wastewater

PART 1 GENERAL

1.01 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required to completely install and put into operation, combination air release/vacuum valves as specified herein and shown on the drawings.

1.02 REFERENCES [NOT USED]

1.03 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.04 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 23.
B. All submittals shall be approved by the Engineer or the Owner prior to delivery.

1.05 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Technical bulletins and brochures on air release valves.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manual

1.07 MAINTANENCE MATERIAL SUBMITTALS [NOT USED]

1.08 QUALITY ASSURANCE

A. The valve shall be the product of a manufacturer regularly engaged in the manufacture of Air release/air vacuum valves having similar service and size. The valves covered by the specifications are intended to be standard equipment that has proven ability.

1.09 DELIVERY, STORAGE, AND HANDLING

A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

B. All equipment and parts must be properly protected against any damage during a prolonged period at the site.

C. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

D. Storage and Protection: Take special care to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, preventing any deformation.

1.10 FIELD CONDITIONS

A. The air release/air vacuum valve shall operate satisfactorily over the complete operating range shown. The equipment to be provided under this section shall be suitable for installation and operation at elevations between 550-600 feet above sea level. Outside ambient temperatures range between 0 and 110 degrees F, and reported water temperatures vary between 50 and 105 degrees F. Relative humidity is expected to range between 5 and 100 percent. The valve shall be capable of being submerged periodically.

1.11 WARRANTY:

A. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced, and the unit(s) restored to service at no expense to the Owner. Warranty shall be for a period of two (2) years and begin on the Date of Final Acceptance.

PART 2 PRODUCTS

2.01 AIR RELEASE/AIR VACUUM VALVE

A. Manufacturers

1. The following manufacturers and models are acceptable

a. 6” Air Release Valve

1) Vent-O-Mat RGX Anti-shock

2) ARI D-020-SS

3) APCO ASU

4) Approved Equal

2. The listing above does not imply that the manufacturer's standard product is acceptable. The successful manufacturer will be required to conform to all specifications.

B. Description

1. The air vacuum valve shall achieve the following functions:

    a. High volume discharge during pipeline filling

    b. High volume intake through the large orifice

    c. Pressurized air discharge

    d. Surge Dampening – Controlled discharge rates

2. The valve shall have an integral surge alleviation mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure due to high velocity air discharge or the subsequent rejoining of the separated water columns. The limitation of the pressure rise shall be achieved by decelerating the approaching water prior to valve closure.

3. The valve shall perform as intended with no deformation, leaking or damage of any kind for the pressure ranges indicated.

C. Performance/Design Criteria

1. The arrangement shown on the drawings is based upon the best information available to the Engineer at the time of design and is not intended to show exact dimensions to any specific equipment unless otherwise shown or specified. Therefore, it may be anticipated that the structural supports, foundations, and connected piping shown, in part or in whole, may have to be changed in order to accommodate the equipment furnished. No additional payment will be made for such changes. All necessary calculations and drawings for any related redesign shall be submitted to the Engineer for his approval prior to beginning the work.

2. The valve shall be designed to operate with the following working conditions without damage to the valve.

6" AIR RELEASE VALVE	
Water Type	Wastewater
Working Pressure Range	2 psi – 45 psi

Total (Working + Surge) Pressure	175 psi
Flow Range	0.25 MGD – 24 MGD

D. Materials

1. All internal parts shall be a non-corroding material such as stainless steel or high-density polyethylene.

2. The valve body shall be constructed of stainless steel.

3. Intake and discharge orifices shall be threaded.

PART 3 EXECUTION

3.01. All air release valves shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings.

END OF SECTION

SECTION 40 61 07
POLYVINYL CHLORIDE (PVC) GRAVITY SANITARY SEWER PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Polyvinyl Chloride (PVC) pipe 4-inch through 27-inch for gravity sanitary sewer applications

1.2 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
   2. American Association of State Highway and Transportation (AASHTO).
   3. ASTM International (ASTM):
      a. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
      b. D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
      c. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
      d. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
      e. F679, Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
   4. Texas Commission on Environmental Quality (TCEQ):
      a. Title 30, Part I, Chapter 217, Subchapter C, Rule 217.53 – Pipe Design.
      b. Title 30, Part I, Chapter 217, Subchapter C, Rule 217.54 – Criteria for Laying Pipe.
      c. Title 30, Part I, Chapter 217, Subchapter C, Rule 217.57 – Testing Requirements for Installation of Gravity Collection System Pipes.
   5. Underwriters Laboratories, Inc. (UL).

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01340.

B. All submittals shall be approved by the Owner prior to delivery.

1.4 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data
   1. Product data sheet
   2. Manufacturer
   3. Nominal pipe diameter
   4. Standard dimension ratio (SDR)

5. Cell classification
6. Laying lengths

B. Certificates

1. Furnish an affidavit certifying that all PVC Gravity Pipe meets the provisions of this Section and has been air and deflection tested and meets the requirements of ASTM D3034 and ASTM F679.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Manufacturers
   a. Finished pipe shall be the product of 1 manufacturer for each size per project, unless otherwise approved by the Owner.
      1) Change orders, specials and field changes may be provided by a different manufacturer upon Owner approval.
   b. Pipe manufacturing operations shall be performed under the control of the manufacturer.
   c. All pipe furnished shall be in conformance with ASTM D3034 (4-inch through 15-inch) and ASTM F679 (18-inch through 27-inch).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements

1. Gravity pipe shall be stored and handled in accordance with the manufacturer's guidelines.
2. Secure and maintain a location to store the material in accordance with Section 01 66 00.

PART 2 - PRODUCTS

2.1 EQUIPMENT, PRODUCT TYPES AND MATERIALS

A. Manufacturers
   a. The manufacturer must comply with this Specification and related Sections.

B. Performance / Design Criteria

1. Pipe
   a. Meet all requirements of TCEQ.
   b. Design in accordance with ASTM D3034 for 4-inch through 15-inch SDR 26 and ASTM F679 for 18-inch through 27-inch 46PS/115PS.
   c. PVC Gravity Sanitary Sewer Pipe shall be approved by the UL.
   d. Assume a standard lay length of 14 feet and 20 feet except for special fittings or closure pieces necessary to comply with the Drawings.
   e. Use green coloring for ground identification as sanitary sewer pipe.
   f. PVC meeting the requirements of ASTM D1784, with a cell classification of 12454 or 12364
   g. Deflection Design
      1) Base pipe design on pipe stiffness, soil stiffness and load on the pipe.

2) Design pipe according to the Modified Iowa Formula as detailed by the Uni-Bell PVC Pipe Association in the Handbook of PVC Pipe, using the following parameters:
   a) Unit Weight of Fill (w) = 130 pounds per cubic foot
   b) Live Load = AASHTO HS 20
   c) Trench Depth = 12 feet minimum, or as indicated in Drawings
   d) Maximum (E') = 1,000 max
   e) Deflection Lag Factor (DL) = 1.0
   f) Bedding Factor constant (K) = 0.1
   g) Mean radius of the pipe (r), inches, as indicated in Drawings
   h) Marston's load per unit length (W), pounds per inch, calculate per Drawings
   i) PVC modulus of elasticity (E) = 400,000 psi
   j) Moment of inertia of pipe wall per unit length, (I) = $t^3/12$, (in^4/in), per pipe type and size
      (1) Where (t) = pipe thickness, inches
   k) Maximum Calculated Deflection = 5 percent

h. Pipe Flotation: If the pipe is buried in common saturated soil (about 120 pounds per cubic foot) with at least 1½ pipe diameters of cover, pipe is generally not subject to flotation. If shallower, check groundwater flotation potential. Flotation will occur if:

$$F_b > W_p + W_f + W_d$$

Where: F_b = buoyant force, pound per foot
W_p = empty pipe weight, pound per foot
W_f = weight of flooded soil, pound per foot
W_d = weight of dry soil, pound per foot

Values and formulas for the above variables can be obtained from the pipe manufacturer and site specific soil conditions.

i. Verify trench depths after existing utilities are located.
j. Accommodate vertical alignment changes required because of existing utility or other conflicts by an appropriate change in pipe design depth.
k. In no case shall pipe be installed deeper than its design allows.

2. Minimum pipe stiffness of 46 psi at 5 percent deflection when test in accordance with ASTM D2412.
3. Pipe markings
   a. Meet the minimum requirements of ASTM D3034 and ASTM F679.
   b. Minimum pipe markings shall be as follows:
      1) Manufacturer's Name or Trademark and production record
      2) Nominal pipe size
      3) PVC cell classification
      4) ASTM or Standard Dimension Ratio (SDR) designation
      5) Seal of testing agency that verified the suitability of the pipe
4. Joints
   a. Joints shall be gasket, bell and spigot, push-on type conforming to ASTM D3212.
   b. Since each pipe manufacturer has a different design for push-on joints; gaskets shall be part of a complete pipe section and purchased as such.

5. Connections
   a. Only use manufactured fittings.
6. Detectable Metallic Tape

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
   1. Install pipe, specials and appurtenances as specified herein, as specified in Section 02221, and in accordance with the pipe manufacturer's recommendations.
   2. Lay pipe to the lines and grades as indicated in the Drawings.
   3. Excavate and backfill trenches in accordance with Section 02221.
   4. Embed PVC pipe in accordance with Details.

B. Pipe Handling
   1. Haul and distribute pipe and fittings at the project site.
   2. Handle piping with care to avoid damage.
      a. Inspect each joint of pipe and reject or repair any damaged pipe prior to lowering into the trench.
      b. Use only nylon ropes, slings or other lifting devices that will not damage the surface of the pipe for handling the pipe.
   3. At the close of each operating day:
      a. Keep the pipe clean and free of debris, dirt, animals and trash – during and after the laying operation.
      b. Effectively seal the open end of the pipe using a gasketed night cap.

C. Pipe Joint Installation
      a. Clean dirt and foreign material from the gasketed socket and the spigot end.
      b. Assemble pipe joint by sliding the lubricated spigot end into the gasketed bell end to the reference mark.
      c. Install such that identification marking on each joint are oriented upward toward the trench opening.
      d. When making connection to manhole, use an elastomeric seal or flexible boot to facilitate a seal.

D. Detectable Metallic Tape Installation
   1.

3.2 FIELD [OR] SITE QUALITY CONTROL

A. Field Tests and Inspections
   1. Video Inspection
      a. Provide a Post-CCTV inspection in accordance with Section 02763.
   2. Air Test and Deflection (Mandrel) Test
      a. Perform in accordance with Section 01410.

END OF SECTION

SECTION 40 61 13
PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. A Process Control System Supplier (PCSS) shall furnish all services and equipment defined herein and in other specification sections as listed in Paragraph 1.03, Related Work.

B. All materials, equipment, labor, and services required to achieve a fully configured integrated and operational process control system shall be provided. The PCSS shall design and coordinate the process control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications and with related existing equipment.

C. All configuration and integration, of proposed equipment shall be performed by PCSS which includes but not limited to the Lift Station Control Panel, Auto dialer, and Blower Control Panel.

D. Auxiliary and accessory devices necessary for system operation or performance to interface with existing equipment or equipment provided by other suppliers under other sections of these specifications, shall be included whether or not they are shown on the drawings. These devices include but are not limited to, transducers, current isolators, signal conditioners, interposing relays, power supplies, and fiber optic transceivers.

E. Substitution of functions or type of equipment specified shall not be acceptable. In order to ensure parts are interchangeable, maintain quality, the interface between the various subsystems, and establish minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. System design shall allow for the removal of individual devices from service without disrupting other devices in service.

F. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detailed drawings, specifications, engineering data, instructions, and recommendations by the equipment manufacturer as approved by the Engineer.

G. The PCSS shall be responsible for calibrating all existing instruments that will interface with the new control system.

H. To facilitate the Owner's future operation and maintenance, products shall be by the same major manufacturer, with panel-mounted devices of the same type and model as far as possible.

I. The WWTP is an existing plant and all work shall be coordinated with its operating personnel to minimize the impact on daily operations. This plan shall be submitted for review and approval before any work is started on site. The actual sequence of the work is left to the contractor, but extensive pre-planning is necessary to accomplish the work.

J. The WWTP is a fully operational facility monitored and controlled by local panels and PLCs. After the switchover, the PCSS must demonstrate that all new equipment and reused existing equipment is fully functional as specified and shown on the Contract Drawings.

K. The Owner shall retain salvage rights to all material and equipment removed in the course of this work. All materials and equipment retained by the Owner shall be delivered to a point designated by the Owner in Houston, Texas. Any material or equivalent not retained by the Owner shall be removed from the site and disposed of by the General Contractor in accordance with applicable regulations and laws.

L. All equipment and installations shall satisfy applicable Federal, State, and local codes.

M. The Contract Drawings and related specification sections provide additional details showing building plan layouts, instrument device specifications, functional requirements of the system, and interfacing with other equipment.

N. All materials, equipment, labor, and services necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner so that the monitoring and control functions are available when the equipment is ready to be placed into service.

O. The PCSS shall coordinate, and schedule all required testing with the General Contractor, Owner, and Engineer.

P. The PCSS shall coordinate, and schedule all required training with the General Contractor, Owner, and Engineer.

Q. The PCSS shall provide a monthly status report and updated project schedule to the General Contractor to be included in the General Contractor's overall project schedule.

R. The PCSS shall provide control panels for all areas shown on the contract drawings and specified herein. The electrical contractor shall furnish all wiring between the instruments, PLC cabinet, and control panels. The PCSS shall coordinate the termination of all wires in the control panels and PLC cabinet.

1.02 MEASUREMENTS AND PAYMENT

A. UNIT PRICES

i. This item will be measured and paid for as a lump sum.

ii. Payment will be full compensation for all labor, equipment, materials, and supervision for the demolition, cleanup, and other related work necessary for construction as shown on the drawings and specified herein.

iii. Refer to Section 01 22 00 – Unit Prices for unit price procedures.

1.03 RELATED WORK

A. The PCSS shall furnish all materials, labor, and services specified in the following specification sections as required ensuring that a single, coordinated system is supplied:

i. Section 40 61 21 Process Control System Testing

ii. Section 40 61 26 Process Control System Training

iii. Section 40 62 00 Computer System Hardware and Ancillaries

iv. Section 40 66 00 Network and Communication Equipment

v. Section 40 66 33 Fiber Optic Communication Cabling and Connectors

vi. Section 40 67 00 Control System Equipment Panels and Racks

vii. Section 40 67 63 Control Panel-Mounted Uninterruptible Power Supply

viii. Section 40 70 00 Instrumentation for Process Systems

ix. Division 26 – Electrical Identification

B. Divisions requiring coordination shall include, but not be limited to, the following:

i. Division 01 - General Requirements

ii. Division 11 – Equipment

iii. Division 40 - Process Control Systems

iv. Division 15 - Mechanical

v. Division 26 - Electrical

C. The PCSS shall coordinate with all equipment suppliers, mechanical subcontractor, electrical subcontractor, and General Contractor.

1.04 COORDINATION MEETINGS

A. The PCSS shall schedule and administer a minimum of three mandatory coordination meetings. The PCSS shall make arrangements for meetings; prepare agenda with copies to participants at least one week before scheduled meetings. The meetings will be conducted at the WWTP and shall include, as a minimum, attendance by the Owner, Engineer, General Contractor's project engineer, PCSS's project engineer, and the electrical subcontractor.

i. The first coordination meeting shall be held in advance of the first PCSS shop drawing submittal. The purpose of the first meeting shall be for the PCSS to:

a. Summarize their understanding of the project

b. Discuss any proposed substitutions or alternatives

c. Schedule testing and delivery milestone dates

d. Provide a forum for the PCSS to coordinate hardware and software-related issues

e. Request any additional information required from the Owner and/or Engineer.

f. The PCSS shall bring a draft version of shop drawings to the meeting to provide the basis for the Owner/Engineer's input into their development.

ii. The second coordination meeting shall be held after the Field Instruments, Digital System Hardware, and Control Panels and Panel Mounted Equipment shop drawing submittals have been reviewed by the Engineer and returned to the PCSS. The purpose of the second meeting is to:

a. Discuss comments made on the submittal packages

b. Refine scheduled milestone dates

c. Coordinate equipment installation activities

iii. The last coordination meeting shall be held one month prior to factory acceptance testing. The purpose of the last coordination meeting is to discuss any remaining coordination requirements.

B. A typical agenda may include, but is not limited to, the following:

i. Review minutes of previous meetings

ii. Review of work progress

iii. Field observations, problems, and decisions

iv. Identification of problems, which impede planned progress

v. Review of submittal schedule and submittal status

vi. Review of off-site fabrications and delivery schedules

vii. Maintenance of progress schedule

viii. Corrective measures to regain projected schedules

ix. Planned activities for subsequent work period

x. Coordination of projected progress

xi. Maintenance of quality and work standards

xii. Effect of proposed changes on progress schedule and coordination

xiii. Other business relating to the project

C. The costs associated with the coordination meetings, including auto expenses, meal expenses, etc., shall not be included as part of the work of this section.

1.05 SUBMITTALS FOR PCSS

A. General Requirements:

i. Refer to Division 01 for general submittal requirements.

ii. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.

iii. Submittals shall be bound in separate three ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch, then folded to 8.5 inch by 11-inch for inclusion within the binder. Maximum binder size shall be 3-inches.

iv. The submittal drawings' title block shall include, as a minimum, the PCSS's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.

v. Exceptions to the Specifications or Drawings shall be clearly defined by the PCSS in a separate section of each submittal package. The submittal shall contain the reason for the exception, the exact nature of the exception and the proposed substitution so that the Engineer may make a proper evaluation. The acceptability of any device or methodology submitted as an "or equal" or "exception" to the specifications shall be at the sole discretion of the Engineer.

vi. The PCSS shall submit all the submittals in accordance with this Section. Incomplete or partial submittals not complying with the submittal arrangements outlined in this Section will be returned without review.

vii. Separate submittals shall be made as follows:

a. Qualifications Submittal

b. Project Plan and Schedule Submittal

c. Coordination Meetings Agenda

d. Hardware, Panel Drawing, Loop Drawing, and Software Submittal.

e. Spares, Expendables, and Test Equipment Submittal.

f. Certification of Installation Submittal.

g. Application Development Submittal.

h. Final System Documentation

1) Preliminary O&M Outline Plan Submittal

2) Operations and Maintenance Manual Submittal

i. Qualifications Submittal:

1) Submit, within 15 calendar days after the Notice to Proceed, detailed information on staff and organization to show compliance with the Quality Assurance requirements of this Section. The Qualifications submittal shall be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements shall be grounds for rejection as a PCSS. The Qualifications Submittal shall, as a minimum, contain the following:

a) Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.

b) Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.

c) Copy of UL-508/UL-698 certificate for panel fabrication facilities.

d) Project references for water or wastewater projects as defined in the Quality Assurance paragraphs.

e) Documentation to demonstrate the ability to complete this project including: resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

j. Project Plan, Deviation List, and Schedule Submittal:

1) Submit, within 45 calendar days after Notice to Proceed, a Project plan. The Project Plan shall be submitted and approved before further submittals shall be accepted. The Project Plan shall, at a minimum, contain the following:

a) Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. A discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications shall be included as applicable.

b) Preliminary software and hardware submittal information solely to determine compliance with the requirements of the Contract Documents prior to the PCSS development of process control programs and system layouts. A favorable review of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein.

c) Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include the resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.

d) Preliminary coordination meeting agendas as specified herein.

e) Preliminary testing plan.

f) Preliminary training plan.

g) Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop, and I/O wiring diagrams.

h) Exceptions to the Specifications or Drawings shall be clearly defined in a Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

i) Project schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate I&C related major project milestones including the following:

i. Schedule for all subsequent project submittals. Include the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.

ii. Proposed dates for all project coordination meetings.

iii. Hardware purchasing, fabrication, and assembly (following approval of related submittals).

iv. Shipment of instrument and control system equipment.

v. Installation of instrument and control system equipment.

vi. Testing: Schedule for all testing.

vii. Schedule for system cutover, startup, and/or going on-line for each major system.

viii. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.

k. Coordination Meetings Agenda: Agendas shall be submitted for the Coordination Meetings as specified herein. Submit the proposed Control System Coordination Meeting Agenda a minimum of two weeks prior to the scheduled meeting date for review and comment by the Engineer.

l. Field Instruments Submittal:

1) Refer to the Instruments section for submittal requirements.

m. Hardware and Software Packages Submittal:

1) Refer to the sections below for specific Hardware and Software Packages submittal requirements:

a) Section 40 62 00 Computer System Hardware and Ancillaries

b) Section 40 66 00 Network and Communication Equipment

c) Section 40 67 00 Control System Equipment Panels and Racks

d) Section 40 67 63 Control Panel-Mounted Uninterruptible Power Supply

2) For each hardware and software packages component specified in the sections above, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. The preferred format for the cover page is ISA-TR20.01.01-2007, general data sheet; however, other formats will be acceptable provided they contain all required information.

n. Panel Layout Drawings and Wiring Diagrams Submittal:

1) Refer to the Control Panels section for submittal requirements.

o. Testing Plan Submittals:

1) Refer to Section 40 61 21 Process Control System Testing for specific testing submittal requirements.

p. Training Plan Submittals:

1) Refer to Section 40 61 26 Process Control System Training for specific training requirements.

q. Spares, Expendables, and Test Equipment Lists Submittal:

1) Submit a list of, and descriptive literature for, spares, expendables, and test equipment.

2) Submit a list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.

3) Submit unit and total costs for the additional spare items specified or recommended for each subsystem.

r. Certification of Installation

1) After completion of system installation, submit written certification on PCSS's letterhead that the system installation has been completed to the PCSS's satisfaction as specified.

s. Operations and Maintenance (O&M) Manuals:

1) Submit in accordance with Division 01.

2) Furnish O&M manuals as specified herein.

3) The operations and maintenance manuals shall, at a minimum, contain the following information:

a) Table of Contents:

i. A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.

b) Instrument and Equipment Lists:

i. The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD.

ii. An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

iii. An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

c) Equipment Operations and Maintenance Information:

i. ISA-TR20.00.01-2007 data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. The preferred format for the cover page is ISA-TR20.00.01-2007, general data sheet; however, other formats will be acceptable provided they contain all required information.

ii. Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.

iii. Provide the record documentation of the system audit as specified in Section 40 61 21 Process Control System Testing.

iv. Include the calibration forms developed as specified in Section 40 61 21 Process Control System Testing.

d) As-Built Drawings:

i. Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.

ii. As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.

e) Electronic O&M Information:

i. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.

ii. Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.

iii. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.

iv. Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.

v. If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format shall be a minimum of 800 by 600 pixels and shall include sound.

f) The cover and edge of each volume shall contain the following information:

Project Name (refer to Contract Documents)
Contract Number (refer to Contract Documents)

Instrumentation and Control System
Hardware Operations and Maintenance Manual
Specification Sections _____, _____, _____

Subcontractor Name
Date
Volume X of Y
(Where X is the volume number and Y is the number of volumes)

g) Retrofit Documentation - The PCSS shall investigate, diagnose, repair, update and distribute all pertaining documentation of deficiencies, which become evident during the warranty period. All such documentation shall be submitted to the Engineer within 30 days of solving the problem.

1.06 COORDINATION MEETINGS

A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, and the PCSS's Project Engineer, if applicable. Other Division 40 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. The meeting shall be scheduled for a minimum of one week before the requested meeting date.

i. A project kickoff coordination meeting shall be held within two weeks of submitting the Project Plan. The purpose of the meeting shall be to discuss the PCSS's Project Plan, summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software-related issues, and request any additional information required from the Owner. The meeting will last up to one business day.

ii. A submittal review coordination meeting shall be held after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting shall be to review comments made on the submittal package; refine scheduled deadline dates; and coordinate equipment installation activities. The meeting will last up to one business day.

iii. Regular on-site meetings when the PCSS staff is at the plant site.

1.07 REFERENCE STANDARDS

A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

B. International Society of Automation (ISA):

i. ISA S5.2, Binary Logic Diagrams for Process Operations.

ii. ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

iii. ISA S5.4, Instrument Loop Diagrams.

iv. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

v. ISA RP60.3, Human Engineering for Control Centers.

vi. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers.

vii. ISA-99, Industrial Automation and Control Systems Security.

C. National Electrical Manufacturers Association (NEMA).

D. National Fire Protection Agency (NFPA):

i. NFPA 70, National Electrical Code (NEC).

ii. NFPA 79, Industrial Control Equipment.

E. Underwriters Laboratories, Inc. (UL):

i. UL 508/UL-698 - Industrial Control Equipment - for custom fabricated equipment.

ii. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off-the-shelf products.

1.08 QUALITY ASSURANCE

A. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

i. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.

ii. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of a similar size to this project.

iii. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

B. The PCSS shall maintain a permanent, fully staffed, and equipped service facility within 200 miles of the project site with full-time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before the scheduled start up to two months after startup completion.

C. PCSS shall hold a valid UL-508/UL-698 certification for their panel fabrication facility.

D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on-site supervision to the installers of the various components.

E. PCSS shall be one of the following:

a. Prime Controls
12144 Dairy Ashford Rd. Bldg. 3
Sugar Land, TX 77478
Attn: Brian Poarch
Phone: 713.244.9747

b. Weimar Manufacturing, Inc.
505 S Eagle St,
Weimar, TX 78962
979.725.8527

c. Ace Controls LLC
327 Derrick Dr.
Humble, TX 77338
713.589.5494

d. Texas Industrial Control Manufacturing
1634 S 7th St,
Conroe, TX 77301
936.703.5102

e. Concentric Integration
11450 Compaq Center West Dr. Ste 660
Houston, TX 77070

f. BL Technology, Inc.
1730 S Cherry St.
Tomball, TX 77375
Phone: 832.698.8000

F. Being listed in this specification does not relieve the PCSS from meeting the qualifications specified in this Section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Provide Delivery, Storage, and Handling requirements per Division 01 and as specified below.

B. Shipping Precautions

i. After completion of shop assembly, factory test, and approval of all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy-duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing the protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

ii. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.

iii. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.

iv. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.10 NOMENCLATURE AND IDENTIFICATION

A. Field Instrument Tags

i. See plan drawings.

B. Panel Nameplates:

i. See plan drawings and Section 40 67 00 Control System Equipment Panels and Racks.

1.11 WARRANTY

A. Provide warranty per Division 01, Warranties and Bonds, and as specified herein.

B. AESS application work will be provided with telephone technical support within 4 hours of a warranty claim. If a failure cannot be resolved by telephone, provide onsite technical support within 24 hours of a warranty claim.

1.12 O & M MANUALS

A. Prior to final acceptance of the system and owner training, operating and maintenance manuals covering instruction and maintenance on each type of equipment shall be furnished in accordance with Division 01, Operating and Maintenance Data.

B. The instructions shall be bound in three ring binders with Drawings reduced or folded for inclusion and shall provide the following as a minimum:

i. A comprehensive index

ii. A complete "As Constructed" set of approved shop Drawings

iii. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data

iv. Full specifications for each item

v. System schematic drawings “As Constructed,” illustrating all components, piping and electrical connections of the systems supplied under this Section

vi. Detailed service, maintenance, and operation instructions for each item supplied

vii. Special maintenance requirements particular to this system clearly defined, along with special calibration and test procedures

viii. Operating instructions which incorporate a functional description of the entire system, with references to the systems schematic Drawings and instructions

ix. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier

C. The final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacently to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

D. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

E. If the PCSS transmits any documentation or other technical information, which he considers proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the design, construction, operation, or maintenance of the system and, to the extent permitted by law, will not be published or otherwise disclosed.

F. The final documentation requirements are as follows:

i. As-built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as built system. Any errors in or modifications to the System resulting from the Factory and/or Field Acceptance Tests shall be incorporated in this documentation.

ii. The Hardware Maintenance documentation shall describe the detailed preventive and corrective procedures required to keep the System in good operating condition. Within the complete Hardware Maintenance documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance documentation shall include, as a minimum, the following information:

a. Operation Information - This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

b. Preventive Maintenance Instructions - These instructions shall include all applicable visual examinations, hardware testing, diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

c. Corrective Maintenance Instructions - These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

d. Parts Information - This information shall include the identification of each replaceable or field repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between the Instrumentation System Supplier's part number and manufacturer's part numbers shall be provided.

e. System Backup/Restore - This information shall include a detailed description of the procedure for backing up the computer system (including PC and PLC); reloading using a backup; and completely restoring a PC and/or PLC from a backup.

1.13 PARTIAL PAYMENT SCHEDULE

A. The partial payments to the General Contractor for work provided under this section shall satisfy the following limiting criteria (percent of the lump sum pay for all items and related work provided under this section):

i. Approval of all required submittals - 5 percent (excluding O&M manuals)

ii. Completion of all factory acceptance tests - 10 percent

iii. Delivery of equipment to job site and properly stored - 5 percent

iv. Installation and functional demonstration tests- 25 percent

v. Completion of training - 15 percent

vi. Delivery of final approved O&M manuals - 15 percent

vii. Completion of 30 day acceptance test - 15 percent

viii. Each item above shall be completed in full before any partial payment is made for that item.

1.14 MAINTENANCE CONTRACT

A. A written proposal for a maintenance contract executed by the PCSS shall be provided to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. The cost of this maintenance contract shall not be included in the Contract Price.

B. This proposal shall be provided within 30 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.

C. This maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment and software provided as part of the PCSS scope of work.

D. Provide software updates throughout the maintenance contract period. Provide latest official released version for all software provided under this Contract. Owner shall have the latest software releases at the end of the maintenance contract period.

E. The maintenance contract shall also include a minimum of 4 preventive maintenance visits by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning and lubrication of system equipment and verification of correct operation.

F. Visits to the sites to correct deficiencies under warranty shall not be included in this preventive maintenance service contract.

G. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit, however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the system hardware preventive and corrective maintenance.

H. During the one-year maintenance period, observation of maintenance operations by plant personnel and the instruction of said personnel in the details of the maintenance work being performed, shall be provided.

1.15 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements. Air-conditioned areas require NEMA Type 12 ventilated enclosures. The equipment below grade shall be NEMA Type 4X. All other areas require NEMA Type 4X stainless steel enclosures. Refer to Division 26 for area environmental hazardous classifications. All instrumentation enclosures and all instruments mounted outdoors shall be furnished with sun shields.

B. Elevation. Equipment shall be designed to operate at a ground elevation of approximately 1500 feet above mean sea level.

C. Temperature. Indoor areas' equipment shall be suitable for 10 to 35 C degrees ambient. Outdoor areas' equipment shall be suitable for 30 to 50 C degrees ambient. Storage temperatures shall range from zero to 50 C degrees ambient. Additional cooling or heating shall be furnished if required by the equipment.

D. Relative Humidity. Air-conditioned area equipment shall be suitable for 20 to 95 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.

E. Power Supply. 120 volts AC sources of electric supply shall be unregulated industrial panel boards.

PART 2 PRODUCTS

2.01 GENERAL

A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture, and fungus. The field-mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Division 26. Provide minimum size anchor of 3/8-inch.

C. All indicators shall be linear in process units unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.

D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

E. All electronic/digital equipment shall be provided with radio frequency interference protection.

F. Electrical:

i. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

ii. With the exception of field device network-connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms unless specified otherwise. However, signals between instruments within the same panel or cabinet maybe 1-5 VDC (volts direct current).

iii. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.

iv. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA unless noted otherwise.

v. Switches and/or signals indicating an alarm, failure, or upset condition shall be wired in a fail-safe manner. A fail-safe condition is an open circuit when in an alarm state.

vi. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.

vii. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory and shall resume normal operation without manual resetting when power is restored unless otherwise noted.

2.02 ELECTRICAL SURGE PROTECTION

A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground.

B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted,, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.

C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.

D. Non-Fiber Based Data Highway or Communications Circuits - Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, Citel DLA series or MJ8 series, or equal.

E. Inductive Loads - Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.

F. Telephone Circuits - At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

2.03 SPARE PARTS

A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.

B. Furnish one of each type of installed Surge protection devices.

C. Other spare parts are specified in each section. An overview follows:

i. Devices within Control Panels - See the control panels section.

ii. Computer Hardware and Software spare parts - See the Computer System Hardware section.

iii. Network and Communications System - See the Control and Data Network Equipment section.

iv. Instrument related Spare Parts - see the Instrument section(s).

PART 3 EXECUTION

3.01 PCSS GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms, and similar devices indicated are approximate only. The exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.

B. Provide brackets and hangers required for mounting equipment.

C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 26.

E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.02 TESTING

A. Refer to Section 40 61 21 Process Control System Testing.

3.03 TRAINING

A. Refer to Section 40 61 26 Process Control System Training.

END OF SECTION

SECTION 40 61 21
PROCESS CONTROL SYSTEM TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.

B. Refer to Section 40 61 13 – Process Control System General Provisions.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 40 61 13.

1.03 RELATED WORK

A. Refer to Section 40 61 13 – Process Control System General Provisions.

B. Division 01 - Equipment Testing, Start-up, and Commissioning

1.04 SUBMITTALS

A. Refer to Section 40 61 13 – Process Control System General Provisions.

B. Refer to Div 01 - Equipment and Facility Commissioning for performing equipment, System, and Subsystem Testing.

C. Testing Submittals - Submit, in one submittal, the following testing related documents:

i. Status signoff forms:

a. Develop and submit Project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign-off. Include sign-off forms for each testing phase showing all loops.

1) Example forms are shown in the Appendices.

2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.

3) Submit blank testing forms labeled for each instrument, device, or component to be tested prior to the start of testing.

ii. Testing Procedures:

a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures shall serve as the basis for the execution of the required tests to demonstrate that the system meets the Specifications and functions as specified.

b. Documents shall be structured in an orderly and easy-to-follow manner to facilitate an efficient and comprehensive test.

c. Test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.

d. Test procedures shall be structured in a cause-and-effect manner where the inputs are indicated, and the outputs are recorded.

e. Test procedures shall include the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.

D. Test Documentation:

i. Upon completion of each required test, document the test by submitting a copy of the signed-off Testing Status forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for formal test documentation.

1.05 MAINTENANCE- NOT USED

1.06 COST OF TRAVEL

A. Scheduled tests will only be attended once by Engineer /Owner. If the test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse the Owner for all costs, including labor and expenses, invoiced by the Engineer and incurred by the Owner for subsequent retests.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TESTING - GENERAL

A. Refer to Div 01 and Section 40 61 13. Coordinate testing with the project construction schedule. This may require some tests to need to be repeated over the course of the project.

B. Testing may not start until all Testing Submittals have been approved.

C. Results of all testing shall be tracked on a Project specific status sign-off form or similar document. PCSS shall be responsible for maintaining the sheet. The appendix of this Section has an example template for this sheet.

D. Tests the PCSS is required to perform are as follows:

i. Factory Testing:

a. Unwitnessed Factory Test (UFT).

b. Witnessed Factory Test (WFT).

ii. Field Testing:

a. Operational Readiness Test (ORT).

b. Functional Demonstration Test (FDT).

c. Startup Acceptance Test (SAT).

d. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

E. Each test shall be in the cause-and-effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement shall be satisfied.

F. All tests shall be conducted in accordance with prior Engineer approved procedures, forms, and checklists. Each specific test shall be described and followed by a section for sign-off by the appropriate party after its satisfactory completion.

G. Copies of these sign-off test procedures, forms, and checklists will constitute the required test documentation.

H. Provide all special testing materials and equipment. Whenever possible, perform tests using actual process variables, equipment, and data. Suitable means of simulation shall be provided when it is not practical to test with real process variables, equipment, and data. Define these simulation techniques in the test procedures.

I. The General Contractor shall require the PCSS to coordinate all testing with the Engineer, all affected Subcontractors, and the Owner. The PCSS shall provide written notification to the Owner and Engineer before testing to inform them about the testing schedule. The Owner and Engineer will attend all the testing and sign off on the testing documents.

J. The Engineer/Owner reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures.

K. The Engineer/Owner's decision shall be final regarding the acceptability and completeness of all testing.

L. No equipment shall be shipped to the job site until Engineer has received all Factory Testing results and approved the system as ready for shipment.

M. The PCSS shall furnish servicemen and all special calibration and test equipment to perform the field tests.

N. Correction of Deficiencies:

i. Deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet Specification requirements at no additional cost to Design-Builder.

ii. Testing, as specified herein, shall be repeated after correction of deficiencies is made until specified requirements are met. This work shall be performed at no additional cost to Design-Builder.

3.02 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Purpose of UFT is for PCSS to check the system prior to Engineer/Owner attending factory testing.

B. Temporary network connections will be required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.

C. Hardware to be tested shall include all control system devices shown on System Architecture Drawings and provided by PCSS and vendors.

D. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.

i. All panels and enclosures being provided shall undergo a thorough inspection to verify the integrity of cabinet enclosures, frame structures, paintwork, finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.

ii. Perform a system audit to verify all components have been staged for testing and have been documented properly with correct model numbers, serial numbers, etc. The following documentation of audit shall be provided at the factory test and submitted as part of O&M Manual Documentation:

a. For each workstation and server, list all software installed (including the operating system), with a software revision number, software improvement modules or patches installed, license number and owner registration information, warranty period, Supplier and local distributor names, and contacts.

b. For each microprocessor-based component connected to control communication backbone in the system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, Supplier and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)

iii. Panel wire pull tests shall be performed to ensure all wiring is connected appropriately to prevent wires from coming loose.

iv. UPS shall be tested to verify UPS switch power correctly while keeping all UPS-powered loads online. Testing of UPS to determine if they have been sized correctly to maintain specified run time shall be performed during field testing.

v. For each hardware enclosure, inspection shall include, but not be limited to, cabinet enclosures, frame structure, paintwork and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).

vi. For each subpanel, inspection shall include, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize airflow, power conditioning correctly installed, and overall layout and installation of components meets Supplier's recommendations and standard industry-accepted practices.

vii. All other control panel circuitry.

E. Upon successful completion of UFT, PCSS shall submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify the Engineer/Owner in writing that system is ready for WFT. No other notice of the Factory test will be accepted. The Engineer/Owner shall schedule a test date within 30 days of receipt of this submittal.

3.03 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

A. Purpose of WFT is to allow the Engineer/Owner representatives to witness the functionality, performance, and stability of the entire hardware and software system as a complete integrated system. WFT shall be run by PCSS and conducted at PCSS's facility.

B. Required Documents for Test:

i. Clean set of approved panel drawings and wiring diagrams.

ii. Set of Contract Documents - all Drawings and Specifications.

iii. All design change-related documentation.

iv. Master copy of the PCSS-developed factory testing signoff forms.

v. Testing procedures.

C. System shall operate continuously throughout WFT without failure, except where initiated per established test procedures. Any unanticipated failures may, at the Engineer/Owner option, result in overall WFT being deemed unsuccessful. All deficiencies identified during these tests shall be corrected and re-tested prior to completing WFT or shipment of panels to Jobsite as determined by the Engineer/Owner.

D. Tests to be performed during the WFT shall include, but not be limited to, the following:

i. A repeat of all tests specified in the UFT.

E. Daily schedule during these tests shall be as follows:

i. Morning meeting to review the day's test schedule.

ii. Scheduled tests and sign-offs.

iii. End-of-day meeting to review the day's test results and to review or revise the next day's test schedule.

iv. Unstructured testing period by witnesses.

F. Upon successful completion of WFT, PCSS shall submit a record copy of test results as specified in PART 1.

3.04 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if the equipment is ready for operation.

B. This test shall take place prior to FDT and startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete and tested through continuity check.

C. Required Documents for Test:

i. Master copy of the PCSS-developed field testing signoff forms.

ii. Testing procedures.

iii. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, the Engineer/Owner may review and spot-check the testing process periodically. Any deficiencies found shall be corrected by PCSS prior to the commencement of the Functional Demonstration Test.

E. PCSS shall maintain Sign-off forms and Calibration forms at the job site and make them available to Engineer/Owner at any time.

F. Following tests shall be performed as part of ORT:

i. Instrument calibration, configuration, and set-up.

ii. Local manual operation through LCP through selector and push buttons.

iii. Testing of control strategies.

G. Instrument calibration, configuration, and set-up:

i. Calibrate, configure and set up all components and instruments to perform specified functions.

ii. Calibration form:

a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in the field documenting this information. These forms shall provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.

b. For instruments that are factory calibrated provide calibration certification form provider by the manufacturer.

c. This information shall be added to the Instrument data sheet, shall be added to a copy of the Supplier's standard "Configuration Sheet", or a separate form shall be created.

d. If a separate form, the form shall list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Supplier, Model Number/Serial Number, Output Range, and Calibrated Value.

e. Some examples of required information are:

f. For Discrete Devices: Actual trip points and reset points.

g. For Instruments: Any configuration or calibration settings entered into the instrument.

h. For Controllers: Mode settings (PID).

i. For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).

j. Maintain a copy of these forms in field during testing and make them available for inspection at any time.

k. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to the Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 40 61 13.

H. I/O Testing:

i. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.

ii. PCSS in conjunction with Subcontractor shall test signals under process conditions. The preferred test method will always be to execute tests wherever possible to end elements. For example, the preferred test will prove valve open/close limit switches by operating the valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on the sign-off form.

iii. The following I/O tests shall be performed:

a. Discrete Input: At the device or instrument, change signal condition from inactive to active state. Observe results on all indicators within the loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.

b. Analog Input: Test analog signal over the entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing ranges. Observe results on all indicators within the loop such as HMI screens, OIT screens, recorders, digital indicators, etc.

c. Discrete output signals shall be tested by switching equipment to manual control and turning the output on or using other means to turn the output on. Then verify equipment responds accordingly.

d. Analog output signals shall be tested by switching equipment to manual control and turning the output on or other means to turn the output on. Then verify the signal at the other end of the wiring responds accordingly to the value that is manipulated over the entire engineering control range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing ranges.

I. Testing of Automatic Control Strategies:

i. All automatic control strategies shall be verified using actual process equipment and instruments, or other means, to verify logic performs as expected. Initial tuning of the PID loops shall be completed. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out-of-range testing for analog inputs, loss of power, and all other strategies specified in the control strategy document.

J. Repeat all systems tests specified under factory testing.

K. UPS shall be tested to verify UPS switch power correctly while keeping all UPS-powered loads online. Also, test the sizing of UPS by switching offline power to UPS and verify if they maintain a specific run time as specified in Section 40 67 63.

L. For all panels with enclosures modified by this Contract, internal control panel temperature shall be tested under full running conditions to ensure proper cooling/ventilation is being provided.

M. Upon successful completion of ORT, PCSS shall submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.05 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. After the facility is started-up and running the treatment process in automatic control to the extent possible, a Functional Demonstration Test shall be performed. The purpose of FDT is to allow Engineer/Owner representatives to witness actual functionality, performance, and stability of the system while connected to process equipment.

B. Required Documents for Test:

i. Set of panel drawings and wiring diagrams from ORT with corrections noted.

ii. Set of Contract Documents - all Drawings and Specifications.

iii. All design change-related documentation.

iv. Signed-off master copy of the PCSS-developed field testing signoff forms.

v. Testing procedures.

vi. Copy of completed calibration forms.

vii. One copy of all O & M Manuals for PCSS-supplied equipment.

C. A witnessed FDT shall be performed on each process area. To the extent possible, repeat testing is performed during ORT and complete the final tuning of PID loops.

D. Daily schedule specified to be followed during factory tests shall also be followed during FDT.

E. After coordinating with Operations, a "Black Start" of the plant shall be performed to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. The automatic restart in local or remote mode of operation sequence shall be executed in conformance with the control narratives. Separate tests shall be performed by recovering the plant while on generator and while on utility power.

F. Punchlist items and resolutions noted during the test shall be documented on Punchlist/Resolution form. In event of rejection of any part or function test procedure, PCSS shall perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS shall submit a record copy of test results as specified in "Part 1 - General".

3.06 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After completion of FDT, and the system is started up and running the treatment process in automatic control to the extent possible, the system shall undergo a test as defined in Div 01, Equipment and Facility Commissioning.

B. While this test is proceeding, the Engineer/Owner shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain the responsibility of the Owner and the decision of plant operators regarding plant operations shall be final.

C. During this test, PCSS personnel shall be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of the hardware and software of the system. When PCSS personnel are not on-site, PCSS shall provide cell phone numbers that Design-Builder personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

D. Any malfunction during test shall be analyzed and corrections made by PCSS. In event of rejection of any part or function, PCSS shall perform repairs or replacement within 5 days.

E. Throughout duration of SAT, no software or hardware modifications shall be made to system without prior approval from Engineer/Owner.

3.07 CERTIFICATE OF INSTALLATION

A. Following successful completion of SAT test, PCSS shall submit a Certification of proper installation for system as required in Div 01, Equipment and Facility Commissioning.

END OF SECTION

SECTION 40 61 26
PROCESS CONTROL SYSTEM TRAINING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish training as specified herein.

B. This Section covers the training requirements for all devices and systems furnished and installed as detailed on the Drawings and specifications that are provided, programmed, and configured by PCSS.

C. Refer to Section 40 61 13 – Process Control System General Provisions.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 40 61 13.

1.03 RELATED WORK

A. Refer to Section 40 61 13 – Process Control System General Provisions.

1.04 SUBMITTALS

A. Refer to Section 40 61 13 – Process Control System General Provisions for general submittal requirements.

B. Refer to Div 01 – Vendor Training

C. Preliminary Training Plan Submittal

i. Prior to the preparation of the Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.

D. Final Training Plan Submittal

i. Upon receipt of the Engineer/Owners comments on the preliminary training plan, submit the specific proposed training plan. The training plan shall include:

a. Definitions, objectives, and target audience of each course.

b. Schedule of training courses including proposed dates, duration and locations of each class.

c. Complete copy of all proposed handouts and training materials. Training information shall be bound and logically arranged with all materials reduced to a maximum size of 11 inches by 17 inches, then folded to 8.5 inches by 11 inches for inclusion into the binder.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. The cost of the training programs shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.

B. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

C. All onsite instructors must be intimately familiar with the operation and control of the Owner's facilities.

D. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project. The manuals shall be provided in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.

E. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to Owner.

F. The Owner reserves the right to videotape all custom training sessions. All training tapes shall become the sole property of the Owner.

G. Cost of Travel for off-site training

i. Cost of Travel for off-site training shall be paid directly by the entity employing the staff doing the traveling.

3.02 TRAINING SUMMARY

A. The following training courses listed in the summary table shall, as a minimum, be provided:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience

Onsite Training				
Installed Control System (PCSS)	8	4	1	Maintenance, Administrator
Instruments Training	8	4	1	Maintenance
Instruments Operator Familiarity	2	4	1	Operations
Network Equipment	4	4	1	Management, Operations, Maintenance

B. Definitions of audience roles

i. Administrator - personnel responsible for maintaining the control system.

ii. Maintenance - personnel responsible for maintaining the field controller hardware and instrumentation system.

iii. Operations - personnel responsible for daily plant operations.

iv. Management - non-daily operations personnel

3.03 ONSITE TRAINING

A. Training personnel shall be intimately familiar with the control system equipment, its manipulation, and its configuration. Training personnel shall command a knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and shall be capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training

i. Provide training for the OWNER'S personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. The training shall be held before the Site Acceptance Test (SAT), but not more than two months before.

ii. Training and instruction shall be specific to the system that is being supplied.

iii. Training shall consist of classroom instructions and hands-on instruction utilizing the OWNER'S system.

iv. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the system that will allow the OWNER'S personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. The training shall cover the following subjects, as a minimum:

a. System overview.

b. System hardware components and specific equipment arrangements.

c. Periodic maintenance.

d. Troubleshooting and diagnosis.

e. Network configuration, communications, and operation.

f. TCP/IP addressing procedures for all Ethernet devices.

C. Instrument Training

i. Provide instruction on the maintenance of the field and panel instrumentation for the OWNER'S instrumentation technicians. This training shall be conducted before the SAT, but no more than 1 month before and at a time suitable to the OWNER. This training shall take place at the OWNER'S facility. As a minimum, the following shall be included:

a. Training in standard hardware maintenance for the instruments provided.

b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.

c. Test, adjustment, and calibration procedures.

d. Supplied testing equipment training.

e. Troubleshooting and diagnosis.

f. Periodic maintenance.

D. Instruments - Operator familiarity

i. Provide operator-level instruction on the use of the field and panel instrumentation for the OWNER'S operations staff. This training shall be conducted before the 30-day site acceptance test, but no more than 1 month before and at a time suitable to the OWNER. This training shall take place at the OWNER'S facility. Include a hands-on demonstration of the information each transmitter indicates, and the method used to retrieve any operator information from the transmitter, including the use of pushbuttons and interpretation of international graphic symbols used on the instruments.

END OF SECTION

SECTION 40 62 00
COMPUTER SYSTEM HARDWARE AND ANCILLARIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes all hardware as shown on the Drawings (SCADA System Architecture) and specified herein.

B. Owner to provide Workstations and Thin Clients.

C. Owner to provide Printer.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 40 61 13.

1.03 WARRANTY

A. All equipment supplied under this Section of the Specifications shall be warranted by the Equipment Manufacturer for the warranty period specified in Division 01.

B. The Project Warranties Period shall commence on the Date of Substantial Completion. Substantial Completion will be determined and approved by the Owner Project Director.

C. Provide next day computer manufacturer on-site service for all computer system hardware devices. The on-site service shall be performed by an authorized representative of the manufacture of the installed equipment.

1.04 SUBMITTALS

A. Refer to Section 40 61 13 Process Control System General Provisions.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Section 40 61 13 Process Control System General Provisions.

B. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the latest hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment shall be as follows:

i. Submit for approval the required data for the equipment as part of the Hardware submittal.

ii. The equipment shall be ordered as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit for approval the required data of the latest available hardware and software equivalent in cost to that which is specified. No equipment shall be ordered more than 3 months prior to when it is needed to be continuously used on the Project.

2.02 19-inch RACK ENCLOSURE

A. General:

i. The 19-inch network rack shall be enclosed on all 4 sides with door access in the front and rear and removable panels on each side. subcontractor shall provide the appurtenances required for a fully functional network rack.

B. Features/Performance:

i. Network rack shall be provided with the following appurtenances:

a. Roof fans and tray.

b. Lock and key door switch.

c. Mounting rail brush strip(s).

d. Cable ring set(s) (number as required).

e. Cable management rings (s) (number and size as required).

f. Horizontal cable organizer (number as required).

g. Provide a minimum of 3 inches of wiring space on both sides of the rack enclosure.

ii. Subcontractor shall coordinate the location of all devices in the rack with the City/Design-Builder at the time of installation.

iii. Provide 1 power distribution unit (PDU) in the network rack. The PDU shall be fed from a dedicated 20A power feeder from the UPS and shall be provided for SCADA equipment for which UPS power is required. Each PDU shall include built-in webpage status monitoring via a CAT6 network connection.

iv. Provide 1 power distribution unit (PDUs) in the network rack. Each PDU shall be fed from a dedicated 20A power feeder from the UPS and shall be provided for Security equipment for which UPS power is required. Each PDU shall include built-in webpage status monitoring via a CAT6 network connection.

v. Server rack minimum dimensions:

a. Width: EIA Standard 19-inch Rack Rails

b. External Width: 23.6 inches

c. Height: 78.74-inch Rack Units: 42U

d. Depths: 41.34 inches

vi. Manufacturers

a. APC

b. Dell.

c. Hoffman.

d. Or equal.

2.03 SCADA Large Display Screen/TV

A. General:

i. Contractor to provide and mount a 50” large display screen with built-in TV tuner.

ii. Contractor to coordinate with the Owner on the features and performance requirements to match the Owners existing displays in other facilities.

iii. Contractor to provide the necessary display mount accessories and install the display. Additionally, the installation of the display to adhere to accessibility code requirements.

B. Manufacturer

i. Samsung

ii. No Equal

2.04 SPARE PARTS – None

PART 3 EXECUTION

3.01 GENERAL

A. Refer to Section 40 61 13 Process Control System General Provisions.

END OF SECTION

SECTION 40 63 00
PUMP STATION CONTROL SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. This Specification includes General Requirements for Instrumentation.

B. The Instrumentation System Integrator Contractor shall provide all hardware, software, and configuration and integration associated with the PLC based Instrumentation and Process Control system. Furnish a complete and operational system in accordance with these Contract Documents:

1. Furnish, calibrate, install & commission all instruments shown in drawings and specified in Division 40 specifications (Contract Documents).

2. Furnish control panels as shown on the drawings.

3. Furnish, install and commission complete communication system at the Pump Station.

4. Provide a complete integrated, tested, functional system. Any additional hardware or software required to meet the functional system requirements shall be provided at no additional cost to the OWNER.

1.02 RELATED WORK

A. Comply with General and Special Conditions, Division 1 Specifications, Division 40 Specifications, and Division 26 Specifications of these Contract Documents.

1.03 SECTION INCLUDES

A. Station Controller

1.04 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

1. NEMA ICS 1 - General Standards for Industrial Control and Systems.

2. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

3. NEMA ICS 3 - Industrial Systems.

4. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

5. NEMA ST 1 - Standard for Specialty Transformers (Except General Purpose Type).

B. Instrument Society of America (ISA).

C. Underwriters Laboratories, Inc. (UL).

D. Factory Mutual (FM).

E. Institute of Electrical and Electronic Engineers (IEEE).

F. National Fire Protection Association (NFPA). ANSI/NFPA 70 - National Electrical Code (NEC).

G. Joint Industrial Council (JIC).

H. American National Standards Institute (ANSI).

1.05 SUBMITTALS

A. Submit product data, shop drawings and samples (if samples are requested by the City Engineer) under provisions of Section 01 33 23 - Submittals.

1. Submit in complete packages grouped to permit review of related items as outlined in these specifications.

2. Review of Submittals will be for conformance to Contract Documents and for application to specified functions.

B. Product Data: Submit descriptive product literature including manufacturer's specifications for each component specified.

C. Shop Drawings: Indicate layout and mounting of completed assemblies and systems, interconnecting piping and cabling, dimensions, weights, external power and communication connections and programming information.

1. Panel, Console and Cabinet Information.

a. Layout drawings, including the following:

1) Front, rear, end and plan views to scale.

2) Dimensional information.

3) Tag numbers and functional names of components mounted in and on panels, consoles or cabinets.

4) product information on panel components.

5) Nameplate locations and legends, including text, letter sizes and colors to be used.

6) Location of anchoring connections and holes.

7) Location of external wiring and piping connections.

8) Mounting and installation details.

9) Proposed layouts and sizes of graphic display panels.

b. Wiring and piping diagrams, including the following:

1) Name of panel, console or cabinet.

2) Wiring sizes and types.

3) Piping and tubing sizes and types.

4) Terminal strip numbers.

5) Color coding for each wire and color coding legend.

6) Functional name and manufacturer's designation of components to which wiring and piping are connected.

c. Electrical control schematics in accordance with JIC standards.
d. Plan showing equipment layout in each area.

2. Field Wiring and Piping/Tubing Diagrams

a. Wiring and piping/tubing sizes and types.
b. Terminal strip, device terminal and wire numbers.
c. Color coding.
d. Designation of conduits in which wiring is to be located.
e. Location, functional name and manufacturer's designation of items to which wiring or piping are connected.
f. Point-to-point wiring diagrams identifying every termination point and connection.

3. Instrumentation Diagrams

a. Prepare instrument loop diagrams for analog and digital displays, and control and I/O loop diagrams, using ISA standard symbols in accordance with ISA Standard S5.4. Drawings shall follow the format and include the following:

1) Instrument tag numbers.

2) Functional name, manufacturer's name, product name and model or catalog number of each item.

3) Location of each item.

b. Submit diagrams and schematics as PDFs on 11-inch x 17-inch paper. Use lettering and numerals of at least 1/16-inch nominal height.

4. Lift Station Control Panel System I/O Wiring Diagrams

a. Include the following information:

1) Location and identification of intermediate panel and field terminal block and strip numbers to which I/O wiring and power supply wiring is connected. Identify power supply circuit numbers and ratings.

2) Wiring sizes, types, wire numbers and color coding.

3) Designation of conduits in which field I/O wiring is to be run.

4) Locations, functional names, tag numbers and manufacturer's names and model numbers of panel and field devices and instruments to which I/O wiring is connected. Label wiring and cables at both ends and within junction and terminal boxes. Use machine-printed permanent ink heat-shrink labels by Brady or approved equal.

b. Submit such diagrams and schematics as PDFs on 11 x 17 inch paper. Use lettering and numerals of at least 1/16 inch nominal height.

D. Quality Control Submittals

1. Factory Test Reports: If specified, submit PDF copies.

2. Testing Procedures: Submit testing procedures proposed to verify input, output, and system logic verification. Testing procedures shall detail, as a minimum, verification of required functions as follows:

a. Verification of pump start, pump stop, and well level alarm outputs by simulation of analog signals representing pump level.
b. Verification of each discrete input via external manually-operated switch.
c. Verification of each analog input by connection of external analog indicator in input loop.
d. Verification of each analog output by connection of external analog indicators.

3. Certificates: Under provisions of Section 01450 - Contractor's Quality Control, submit manufacturers' certificates that equipment and systems meet or exceed specified requirements.

4. Instructions: Submit manufacturer's installation instructions for each component specified.

5. Field Reports: Submit 6 copies of Manufacturer's Installation Inspection, Field Calibration and Field-Testing Reports.

E. Operations and Maintenance (O&M) Data.

1. Submit operation and maintenance data notebook in accordance with Section 01350 - Submittals.

2. Information and drawings submitted must reflect the final installed condition. Revise documents requiring updates following testing and start-up.

3. In addition to the content specified in Section 01 33 23 - Submittals, provide the following information:

    a. Name, address and telephone number of the control system supplier's local service representative.
    b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.
    c. Copy of approved submittal information and system shop drawings as specified in Paragraph 1.3, Submittals, with corrections made to reflect actual system as tested, delivered and installed at the site. Provide half-size blackline reproductions of all shop drawings larger than 11 inches x 17 inches.
    d. Complete up-to-date system software documentation.
    e. Original copies of manufacturer's hardware, unprotected software, installation, assembly and operations manuals for the programmable controller and data communication system, single loop and multi-loop controllers and other control system components. In addition to hard copy versions, provide all manuals in PDF format on DVD.
    f. Instructions for Station Controller replacement adjustment, and preventive maintenance procedures and materials.
    g. Control system description and system operation sequence instructions.
    h. For each major system/subsystem, in separate binders, submit programming documentation I/O schematics, control and loop diagrams, electrical drawings, system description, operation instructions AutoCAD and PDF format and files on DVD.

F. Project Record Documents

1. Submit record documents under provisions of Section 01 78 23 - Project Record Documents.

2. Revise system shop drawings, software documentation and other submittals to reflect system as installed. Accurately record locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information and terminal block layouts on rite in the rain all weather writing paper in a suitable drawing pocket installed inside the controller cabinet door.

3. Insert half-size blackline prints of wiring diagrams applicable to each control panel in a clear plastic envelope and store in a suitable print pocket or holder inside each control panel.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer shall be a company specializing in manufacturing products specified in this Section, having proven compatibility with the City's existing facilities

and at least 5 years of documented experience. The company shall maintain service facilities within 100 miles of the project location.

B. System Integrator / Panel shop Qualifications: System Integrator / Panel shop shall be a company specializing in installation of products specified in this Section, having proven experience with the City's existing facilities and at least 5 years of documented record. The company shall maintain service facilities within 100 miles of the project location.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in factory-sealed containers. Store and protect products under provisions of Division 40.

B. Check for damage upon receiving products on site.

C. Store products in a clean, dry area; maintain temperature in accordance with NEMA ICS 1.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature above 32 degrees F and below 104 degrees F during and after installation of products.

B. Maintain area free of dirt and dust during and after installation of products.

C. Provide temporary heating and air conditioning units and equipment required to maintain environmental conditions specified for control and MCC panels.

1.09 MAINTENANCE SERVICE

A. Provide manufacturer's maintenance services for programmable logic controllers for one year from Date of Substantial Completion without additional cost to the City.

PART 2 - PRODUCTS

2.01 LEVEL CONTROLLER

A. Manufacturer and Model

1. Motor Protection Electronics, LLC; Station Controller SC2000 (Refer plan drawings for wiring schematics).

PART 3 - EXECUTION

3.01 SYSTEM DESCRIPTION

A. Level Measurement System: Equip pump station with one independent well level measurement system, consisting of a and associated cable and installation mounting hardware to provide a 4-20 mA loop signal proportional to well level as indicated on the Drawings.

B. Installation: Fabricate and install well for transmitter.

1. Support Hardware: Provide mounting hardware shown on the Drawings for supporting transmitter cable and cord.

2. Access manhole: Provide access manhole where the transmitter can easily be removed, installed, and maintained.

C. Primary Pump Control

1. Level Controller shall monitor the primary level measurement system and control an output relay to start / stop pumps at preselected well levels as indicated on the Drawings.

2. The Level Controller shall provide first-on first-off alternate sequencing of pump starts.

3. Voltage monitor shall cause all pumps to stop in either Primary or Back-up mode. Alarm conditions shall keep the pump out of service and shall only be reset upon normal conditions returning. When power failure condition, control shall automatically operate pumps in primary or back up mode when power is restored without local or remote alarm reset.

4. Overload and high temperature alarms shall cause a pump to stop in either Primary or Back-up mode. Alarm conditions shall keep the pump out of service until reset through the control panel push-button or starter reset.

5. Seal leak alarm shall only annunciate at control panel and not cause pump to stop in either Primary or Back-up mode.

D. Backup Pump Control

1. Accomplish via high level alarm float.

2. Automatic override from primary to backup mode shall also be initiated under the following conditions: When high level alarm is activated.

3. Provide hardware timer for backup control system to stagger pump starts (add time delay relay to pump start relays).

E. The instrumentation systems CONTRACTOR shall coordinate with OWNER and with all the sub-systems suppliers and manufacturers, during bidding, construction, testing, installation and start-up phases of the project. The coordination is to assure that the instruments and pump station are in compliance with the Contract Documents and that the necessary interface signals are provided as specified or required.

F. Provide the OWNER's staff with all required training and operating procedures, at no extra cost to the OWNER. The training schedule shall be coordinated with the OWNER's REPRESENTATIVE.

G. The calibration, testing, and start-up of all the instruments shall be done by the MANUFACTURER's field technician in the presence of the OWNER and OWNER's REPRESENTATIVE. The CONTRACTOR shall provide a list of all manufacturers whose technicians will perform this work. The CONTRACTOR shall also provide a certified calibration report stating that each instrument shown or specified in the Contract Documents has been installed, tested, and calibrated per the MANUFACTURER's recommendations and per these Contract Documents.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and Drawings. Provide sufficient clearance for calibration and maintenance access.

B. Do not install products until major construction is complete.

C. Connect input and output devices as shown on Drawings.

D. Provide complete programming, testing and verification of the programmable controller and associated inputs and outputs, including work required to interface with the existing owner system.

3.03 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division 40.

3.04 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01 77 00 - Closeout Procedures.

B. Demonstrate operation and programming of controller. Provide 2 sessions of 4 hours of instruction each for 4 persons, to be conducted at project site with manufacturer's representative.

C. System demonstration shall include the following:

1. Complete verification of field wiring.

2. Complete verification of system software.

3. Demonstration of functionality of each discrete input and output by simulation of actual field device action.

4. Demonstration of functionality of each analog input and output by actual variations in the process variable (e.g. well level, etc.).

5. Complete demonstration of each alarm by simulation of actual field device action.

6. Complete demonstration and verification (status/alarm points) of 2-way communication with owner's Central Monitoring Facility.

END OF SECTION

SECTION 40 66 00
NETWORK AND COMMUNICATION EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish the labor and materials required to install and bring into operation the control and data network as shown on the Drawings and specified herein.

B. The supply, wiring, and installation of the hardware equipment provided under this specification shall be provided by the PCSS or Security Contractor or Equipment Supplying Vendor or Contractor.

C. The PCSS or Security Contractor or Equipment Supplying Vendor or Contractor, shall provide configuration, documentation, and testing of the control data network equipment, as specified in this Section. PCSS or Security Contractor or Equipment Supplying Vendor or Contractor shall have Industrial network engineering level certification with formal training on installation and configuration of the network data equipment furnished under this Specification.

D. The network shall be capable of supporting communications between all servers, operator workstations, PLCs, RTUs, and other communication devices as shown on the system architecture block diagram(s). Furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules; splice kits, etc. required for a complete and operational network. The system architecture diagram(s) are for network understanding only. Some communication devices may be required for network operation, which may not be explicitly shown on the Drawings.

E. The control and data network shall include all nodes on the network. Communication between nodes may be via Ethernet, serial, fieldbus, or other method as shown on the drawings.

F. The PCSS or Security Contractor or Equipment Supplying Vendor or Contractor will coordinate on all the design, development, and logistic details for the construction, test, and startup to ensure the complete, functional, and secure network connectivity.

G. All work shall be coordinated with the Owner/Engineer. Delays caused for any reason shall be noted and formally submitted to the Owner/Engineer in writing.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 40 61 13.

1.03 RELATED WORK

A. Refer to Division 26 Sections.

B. Refer to the Drawing package.

C. Refer to Section 40 61 13 Process Control System General Provisions.

D. Refer to Section 40 66 33 Fiber Optic Communication Cabling and Connectors.

1.04 SUBMITTALS

A. Refer to Section 40 61 13 Process Control System General Provisions.

B. Descriptive literature, bulletins, catalog cuts, and drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. PCSS or Security Contractor or Equipment Supplying Vendor or Contractor shall submit a complete system architecture diagram showing in schematic form, the interconnections between major hardware components including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules, local operator interfaces, process equipment vendor controllers, and like equipment. The system architecture shall be complete and shall depict all required cables, media type between components, the network protocol used at each network level, and details on connection requirements such as cable pin-outs, port numbers, and rack slot numbers. The intent of this Specification requirement is to develop a diagram that is complete in every aspect to allow the purchase of all required equipment by part number and to allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature. Sheet size shall be 11-inch x 17-inch and using more than one sheet is acceptable.

1.05 REFERENCE STANDARDS

A. TIA/EIA-568-B/C (Series): Commercial Building Telecommunications Cabling Standards.

B. TIA/EIA-569 (Series): Commercial Building Standard for Telecommunications Pathways and Spaces.

C. TIA/EIA-526 (Series): Standard Test Procedures for Fiber Optic Systems.

D. TIA/EIA-604 (Series): Fiber Optic Connector Intermateability Standard (FOCIS).

E. ANSI/TIA-1005-A “Telecommunications Infrastructure Standard for Industrial

F. TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

G. IEC 61000 (Series): Electromagnetic compatibility (EMC).

H. IEEE 802 (Series): Standards for Local and Metropolitan Area Networks.

I. IEEE 1588: Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems

J. Internet Engineering Task Force (IETF) RFC documents

1.06 QUALITY ASSURANCE

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.07 SYSTEM DESCRIPTION

A. System Responsibility:
The Drawings and Specifications depict a control and data network, which shall function as one unit. This network may be comprised of multiple communication protocols over various media.

1.08 MANUFACTURER SUPPORT

A. Provide a written proposal manufacturer support agreement for products specified herein, per Division 01. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the Owner. At a minimum, this agreement shall provide the Owner with:

B. Minimum 8 AM to 5 PM, 5 days per week manufacturer telephone support.

C. Access to the manufacturer's technical support website.

D. Software and firmware updates.

E. Provide a 3-year Cloud Vision subscription for every supplied network rack switch.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.10 PROJECT/SITE REQUIREMENTS

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.11 MAINTENANCE

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.12 WARRANTY

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.13 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 40 61 13 Process Control System General Provisions.

PART 2 PRODUCTS

2.01 INDUSTRIAL SWITCH

A. General:

i. Provide an industrial-managed Ethernet switch for connection to the control network as shown in the Drawings and specified herein.

ii. Switch manufacturer shall be the same as backbone Ethernet switch specified herein so that all Ethernet switches furnished for network topology are from the same manufacturer.

B. Physical Features:

i. Minimum fiber uplinks: 2 x 100/1000 SFP ports.

ii. Minimum fiber Ports: Two (2) Gigabit Ethernet ports shall be hot pluggable into the SFP uplink. Ports shall be duplex LCE and operate at a wavelength of 850 nm over multimode cable.

iii. Minimum copper ports: 4 x 10/100 TX RJ45 ports.

iv. Operating temperature: 0 to 130 °F.

v. Power: 24 VDC redundant power supply inputs.

vi. Enclosure: Metal case, DIN-rail mountable.

C. Network Features:

i. Fault tolerant for use in a ring topology if shown on Drawings. The switch shall be able to detect a blocked port and redirect data flow in the opposite direction within 30ms.

ii. Layer 2 switching.

iii. Full duplex on all port.

iv. Auto negotiation and manual configurable speed and duplex.

v. Wire speed switching fabric.

vi. IEEE 802.1w Rapid Spanning Tree Protocol.

vii. IGMP snooping.

viii. IGMP filtering.

ix. Configuration password protected.

x. Configuration backup capability required.

xi. SNMP V3.

xii. Lock port function for blocking unauthorized access based on MAC address.

D. Additional Features:

i. The switch shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. The alarm shall be programmable. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.

E. Manufacturers:

i. CISCO IE-3000

ii. Hirschmann RSP

iii. Or equal.

2.02 ETHERNET MEDIA CONVERTER

A. General:

i. Provide an Ethernet media converter as shown in the Drawings.

B. Physical Features:

i. RJ45 port: 10/100BaseTX to 100BaseTX.

ii. Fiber uplink: 100BaseTX to 100BaseFX (ST/SC connectors).

iii. Fiber optics: Multi- or single-mode capability as shown in the Drawings.

iv. Operating temperature: 0 to 130 °F.

v. Power: 24 VDC.

vi. Enclosure: DIN-rail mountable.

C. Additional Features:

i. The converter shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. The alarm shall be programmable. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.

D. Acceptable Manufacturers:

i. Phoenix Contact.

ii. N-Tron.

iii. Moxa.

iv. Or Equal.

2.03 CABLE AND CONNECTORS

A. CATEGORY 6 TWISTED PAIR CABLE, unshielded.

i. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

ii. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

iii. Conductors: 100-ohm, 23 AWG solid copper.

iv. Shielding/Screening: Unshielded twisted pairs (UTP).

v. Cable Rating: Riser & Plenum.

vi. Jacket: Blue thermoplastic.

B. Manufacturers:

i. 3M.

ii. Belden CDT Networking Division/NORDX.

iii. General Cable; General Cable Corporation.

iv. Or Equal

C. CATEGORY 6 TWISTED PAIR CABLE, SHIELDED.

i. Description: Shielded, four pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

ii. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

iii. Conductors: 100-ohm, 23 AWG solid copper.

iv. Shielding/Screening: Unshielded twisted pairs (UTP).

v. Cable Rating: Riser & Plenum.

vi. Jacket: Blue thermoplastic, 600 V rated.

D. Manufacturers:

i. Belden CDT Networking Division/NORDX.

ii. 3M.

iii. General Cable; General Cable Corporation.

iv. Or Equal.

2.04 SPARE PARTS

i. General requirements for spare parts are specified in Section 40 61 13 Process Control System General Provisions.

ii. The following Network and Communications System spare parts shall be furnished.

a. One switch of each type provided.

b. Manufacturer's cables - one of each type installed.

c. Five-10-ft CAT 6 cables with connectors installed.

PART 3 EXECUTION

3.01 ESTABLISHING COMMUNICATIONS

A. The PCSS or Security Contractor or Equipment Supplying Vendor or Contractor shall be responsible for establishing all network communications.

i. General

a. Coordination meetings and workshops shall be scheduled with the owner representative to validate the system architecture submittals, construction, installation, network segmentation and IP addresses master table, Network configuration, cybersecurity policies and other related settings.

b. Configure network components to provide the function and protocols indicate on the specification and shown on drawings and coordinate in workshops.

c. Assistance during field testing by being on-site when network communication testing is taking place.

d. Provide documentation relate to all configuration setting and performance for all network devices provided under this contract.

B. Network installation

i. The Contractor shall follow these requirements when installing network equipment and cabling:

a. All cable bundles within the network rack/enclosure shall be secured and tied with Velcro wrap.

b. All cables and equipment shall be installed in strict conformance with the manufacturer's recommendations.

c. Cables shall be installed avoiding sharp bends.

d. Install cable using lubricant designed for cable pulling.

e. Cable ties or other cable supports shall be installed without crimping the LAN cables.

f. Install LAN cables without splices.

g. Installed bend radii shall not exceed 4 times the cable diameter.

h. Terminate all pairs at the jack and the patch panel.

i. Install cables a minimum of 40 inches away from electrical motors and transformers.

j. Install cables a minimum of 12 inches away from fluorescent lighting.

k. Individual pairs will be untwisted less than 1/2 inch at termination points.

l. All cables and terminations shall be labeled with cable designations.

m. Each data port shall be individually labeled with its patch panel/switch port ID.

n. At the completion of the wiring installation, provide the following documentation:

o. A plan-view of the premise(s) showing the jack numbering scheme.

p. A printed certification report for the entire wiring installation showing compliance with all ANSI/EIA/TIA specifications for data cable.

q. Each device with a unique IP address shall be individually labeled with its IP address.

C. Network configuration

i. The Contractor shall provide a configuration report to the Owner/Engineer detailing all the configuration parameters for all Contractor -configured devices that connect to the network, including but not limited to the following:

a. IP address, subnet mask, default gateway assignments.

b. DNS hostname, domain, and server assignments.

c. Speed and duplex configuration for each network interface.

d. Access VLAN configuration or trunking mode for each switch port.

e. User access passwords for network device management.

f. Switch configuration files in text (CLI) format.

g. MRP rings configuration

h. Redundancy configuration

D. Cybersecurity

i. Contractor to coordinate with the Owner and adhere to any established Cybersecurity guidelines.

E. Network testing

i. Specifications and Guidelines

a. All tests, verifications, checks, and recommendations shall be in conformance with the ANSI/TIA standards. ANSI/TIA specifications define electrical and mechanical parameters that are the basis for all tests and test equipment usage defined in this Section.

b. All tests, verifications, checks, and recommendations shall be in conformance with all applicable vendor specifications and guidelines. Manufacturers' specifications and guidelines may define additional electrical and mechanical parameters beyond ANSI/TIA or ISO/IEC specifications and must be included in the basis for all tests and test equipment usage defined in this Section.

ii. Ethernet Network Testing Equipment

a. The Contractor shall utilize any required test equipment, equipment management tools, and additional tools as needed to validate the network installation. All test equipment shall bear current calibration certification from a certified calibration laboratory, as appropriate.

iii. Testing of installed twisted-pair cabling links

a. The installed twisted-pair copper cabling links shall be tested to meet the requirements of the ANSI/TIA/EIA 568-B standards and to the maximum rating for the grade of the installed cable. The following parameters shall be tested for each cable pair and/or for both ends (where applicable):

b. Wire Map: Presence of opens, shorts, crossed, reversed, transposed, and split pairs.

c. DC Loop Resistance.

d. Length.

e. Propagation Delay.

f. Delay Skew.

g. Insertion Loss.

h. Return Loss measured from both ends.

i. Near-End Cross Talk (NEXT).

j. Power Sum Near-End Cross Talk (PSNEXT).

k. Attenuation to Crosstalk Ratio Near-End (ACR-N).

l. Power Sum Attenuation to Crosstalk Ratio Near-End (PSACR-N).

m. Attenuation to Crosstalk Ratio Far-End (ACR-F).

n. Power Sum Attenuation to Crosstalk Ratio Far-End (PSACR-F).

o. Alien Near-End Cross Talk (ANEXT).

p. Power Sum Alien Near-End Cross Talk (PSANEXT).

q. Alien Far-End Cross Talk (AFEXT).

r. Power Sum Attenuation to Alien Crosstalk Ratio Far-End (PSAACR-F).

s. Average PSANEXT loss.

t. Average PSAACR-F.

F. Testing of installed fiber cabling links

i. The installed fiber cabling links shall be tested to meet the requirements of the ANSI/TIA/EIA 568-C standards. Measurements shall be performed according to EIA/TIA-526 standards. The following parameters shall be tested for all fibers in each cable and for all splices, termination, and connections:

a. Fiber continuity and length at both ends.

b. Attenuation (optical power loss) in both directions from the ends of each cable.

c. Polarity.

d. Splice loss.

e. Fiber termination end-face inspections.

f. End-to-end optical quality test with Optical Time Domain Reflectometer (OTDR).

G. Ethernet Network Test Requirements

i. The Contractor shall perform a network walk-through to verify that all applicable installation specifications and environmental classifications were followed. The Contractor shall perform a visual inspection of all cable terminations (fiber and copper).

ii. The installed Ethernet Network System shall be tested for performance and functionality according to the IETF RFC 2544 recommendations. The performance of each network link shall be measured in both directions. The duration of each test trial shall be at least 60 seconds. The following minimum tests shall be performed:

a. Throughput – the maximum rate at which frames can be transmitted from the source to the destination with zero lost frames or errors.

b. Latency – the total time it takes for a frame to travel from source to destination. The minimum, average, and maximum latency values for each frame size shall be reported.

c. Frame Loss – the percentage of frames transmitted that are not received at the destination.

d. Back-to-Back Frames (burstability) – the maximum number of frames that can be sent from the source to the destination within a specified interval with zero lost frames.

e. Jitter – the variation in the arrival time of frames received at the destination.

f. Bit Error Rate – the percentage of bit errors measured at the destination relative to the number of bits sent by the source.

g. Verification of the Link Integrity Status LED on both sides of each link.

h. Verification of proper operation and failover of each redundant component and links.

i. Verification of alarming of each link failure.

j. Verification of configuration parameters for each network component (IP addressing, VLAN and port assignment, speed/duplex settings).

k. Verification of the necessary network services including but not limited to DHCP, DNS, FTP, and HTTP.

l. Upon completion and testing of the installed network, the AESS shall submit test reports in printed form. Test reports shall show all test results performed by the AESS for each port and piece of equipment. Date of test equipment calibration shall also be provided.

H. Network Troubleshooting

i. The Contractor is responsible for trouble-free and reliable network installations. The Contractor shall employ any means necessary to ensure operational networks. The Contractor shall obtain needed test equipment, including but not limited to time-domain reflectometers, protocol analyzers and network sniffers, to troubleshoot problems. The Contractor shall utilize the services of a trained and certified Network Engineer that is regularly involved in troubleshooting network problems, if operational or reliability problems exist.

3.02 TRAINING

A. Refer to Section 40 61 26 Process Control System Training and Division 01 for general training requirements.

END OF SECTION

SECTION 40 66 33
FIBER OPTIC CABLING AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work of this Section includes providing a fiber optic communications infrastructure including, but not limited to, fiber optic cable (FOC), patch panels, terminations, testing, and implementation.

B. The Work includes testing individual fiber cables installed under this Contract and testing a completed fiber optic communications network.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 40 61 13.

1.03 RELATED WORK

A. Delivery, Storage, and Handling in Division 01.

B. 40 61 13 Process Control System General Provisions

1.04 SUBMITTALS

A. Submit the following to the Engineer, in accordance with Division 01:

i. Catalog Data: Catalog data on fiber-optic cable, termination devices, patch panels, breakout enclosures, splice kits, pigtails, and fan-outs where applicable. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature, catalog cuts, and any power supply requirements.

ii. Certification of compliance in writing stating the fiber optic cable, anticipated layout, and components are compatible, acceptable for use, and in compliance with these specifications.

iii. Detailed bill of materials for fiber-optic cable, terminations, patch panels, breakout enclosures, splice kits, connectors, pigtails, and fan-outs.

iv. Drawings indicating the locations of all patch panels, termination points, or breakout enclosures.

v. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the National Institute for Standards and Testing.

B. Provide four samples of each type of cable, splice, and connector termination kit. Four samples of a completed example of each type of splice and connector termination shall be submitted.

C. The Fiber Optic System Supplier shall provide a fiber optic power budget for each cable run in excess of 1000 feet. The budget shall include transmitter power, receiver sensitivity, connector losses, cable losses, and a 3db-aging margin. The fiber optic transmission line shall maintain a minimum of 10db safety margin.

D. Training plan and schedule for fiber optic cable termination training.

E. Test reports.

F. O&M manuals.

1.05 REFERENCE STANDARDS

A. The optical fiber cable shall conform to the latest issue of the following standards documents, which are incorporated by reference into this Section:

i. EIA-455: Standard Fiber Optic Test Procedures (FOTPs) Devices.

ii. EIA-598-A: Standard Colors for Color Identification and Coding.

iii. MIL-202: Test Methods for Electronic and Electrical Component Parts.

iv. MIL-454: Standard General Requirements for Electronic Equipment.

v. MIL-810: Environmental Test Methods and Engineering Guidelines.

vi. EIA-568-B.3: Commercial Building Telecommunications Cabling Standard: Optical Fiber Cabling Components.

vii. ICEA 5-83-696: Fiber Optic Premises Distribution Cable (Indoor/Outdoor).

viii. National Electrical Code (NEC) Article 770.

ix. UL 1581 VW-1 - Vertical Tray Cable Flame Test.

x. UL 1666 - UL Standard for Safety Test for Flame-Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts.

xi. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use IN Air-Handling Spaces.

xii. IEEE Standard 383 - Flame Retardancy.

xiii. DOD-STD-1678.

xiv. National Electrical Manufacturers Association (NEMA).

xv. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

B. All fiber optical cables shall be constructed in accordance with EIA-455, and 100 percent of all optical fibers and jacketing shall meet or exceed the requirements contained in this specification.

1.06 QUALITY ASSURANCE

A. The cable manufacturer shall be ISO9001 certified and registered.

B. The fiber optic cabling system materials furnished under this Section shall be provided by Fiber Optic Suppliers who have been providing these types of materials for the past three years. The Fiber Optic Suppliers shall provide personnel capable of providing technical assistance during installation.

C. The installation of fiber optic cabling system materials furnished under this Section shall be performed by an installation Contractor who has been installing these types of materials and systems for the past three years.

D. The supplier shall furnish five working installation references.

E. The Engineer shall determine whether a product is an equal based upon the information listed herein and the manufacturer's data sheets regarding the models specified. Alternate equipment shall meet the criteria listed herein and all additional information in the manufacturer's data sheets in order to be accepted as an equal.

1.07 SYSTEM DESCRIPTION

A. N/A

1.08 DELIVERY, STORAGE, AND HANDLING

A. The cable shall be packaged in cartons and/or wound on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

B. When the length of an order requires a large wooden reel, the cable will be covered with a three-layer laminated protective material. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel or into housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

C. Test tails shall be at least two meters long. The inner end shall be fastened so as to prevent the cable from becoming loose during shipping and installation. Reels shall be permanently marked with an identification number that can be used by the manufacturer to trace the manufacturing history of the cable and fiber.

D. Wooden reels shall be plainly marked to indicate the direction in which it shall be rolled to prevent the loosening of the cable on the reel.

E. All fiber optic cables shall be attenuated tested. The attenuation of each fiber shall be provided with each cable reel by the manufacturer.

F. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fibers and 850nm and 1300nm for multimode fiber cables after received on site. The manufacturer shall submit the test results prior to the installation of the cable.

G. Packaging

i. The completed cable shall be packaged for shipment on non-returnable wooden reels. It is the responsibility of the Contractor to determine all required cable lengths.

ii. Top and bottom ends of the cable shall be available for testing.

iii. Both ends of the cable shall be sealed to prevent the ingress of moisture.

iv. Each reel shall have a weatherproof reel tag attached identifying the reel and cable. The reel tag shall include the following information:

a. Cable Number Gross Weight.

b. Shipped Cable Length in Meters.

c. Product Number.

d. Date Cable was Tested.

e. Cable Length Markings Item Number.

H. Each cable shall be accompanied by a cable datasheet.

1.09 SPARE PARTS AND TEST EQUIPMENT

A. Spare Parts

i. Provide a minimum of five percent spares of ST connectors and dust covers, but not less than 20 spare ST style connectors and 40 dust covers.

ii. Provide a minimum of five percent spare 36" spare multimode patch cables with connectors (both ends) terminated, but not less than five 36" spare multimode patch cables with connectors (both ends) terminated.

PART 2 PRODUCTS

2.01 GENERAL MATERIALS

A. Cabinets: cabinets shall be provided as indicated in the Contract Drawings.

B. Provide stranded loose tubes and armored optical fiber cables that are suitable for indoor/outdoor applications. These cables shall be flame-retardant for indoor applications and water and fungus resistant for outdoor applications.

C. Optical Fiber Characteristics

i. All fibers in the cable shall be usable fibers and meet the required specifications.

ii. Each optical fiber shall consist of a doped silica core surrounded by concentric silica cladding. The fiber shall be matched clad design.

iii. Multi-mode: Provide multimode, optical glass fiber compatible with LED or laser-based transmission systems with the following fiber types:

D. Manufacturers

i. Corning Cable Systems Corp.

ii. CommScope.

iii. Belden Cable.

iv. Or equal.

2.02 STANDARD 62.5/125 µM FIBER

A. The multimode fiber shall meet EIA/TIA-492AAAA-A-1997, "Detail Specification for 62.5-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers".

i. Geometry

Core Diameter (µm)	62.5 ± 3.0

Core Non-Circularity	≤ 5 %
Cladding Diameter (μm)	125.0 ± 2.0
Cladding Non-Circularity	≤ 1.0 %
Core-to-Cladding Concentricity (μm)	≤ 1.5
Coating Diameter (μm)	245 ± 5
Colored Fiber Nominal Diameter (μm)	253 - 259

ii. Optical

Cabled Fiber Attenuation (dB/km) 850 nm 1300 nm	 ≤ 3.5 ≤ 1.0
Point Discontinuity (dB) 850 nm 1300 nm	 ≤ 0.2 ≤ 0.2
Cabled Effective Modal Bandwidth[1)] (MHz•km) 850 nm	 ≥ 220
IEEE 802.3 GbE Distance (m) 1000BASE-SX Window (850 nm) 1000BASE-LX Window (1300 nm)	 up to 300 up to 550
OFL Bandwidth (MHz•km) 850 nm 1300 nm	 ≥ 200 ≥ 500
Numerical Aperture	0.275 ± 0.015

[1)]As predicted by RML BW, per TIA/EIA 455-204 and IEC 60793-1-41, for intermediate performance laser based systems (up to 1 Gb/s).

2.03 FIBER OPTIC DISTRIBUTION CABLE

A. Multi-fiber cables utilizing 900-micron tight-buffered fibers surrounded by dielectric strength members and a flame-retardant outer jacket. Cables shall meet the application requirements of the National Electric Code® (NEC®) Article 770 and shall be listed accordingly:

i. Non-Plenum Applications - Applicable Flame Tests: UL 1666. Cables shall be listed OFNR (OFCR)

ii. Plenum Applications - Applicable Flame Test: NFPA 262. Cables shall be listed OFNP (OFCP)

B. Cable Specifications

i. Fiber Count: as indicated.

ii. Maximum Tensile Load Short-Term: 148 lbf (660 N)

iii. Maximum Tensile Load Long Term: 45 lbf (198 N)

iv. Minimum Crush Resistance: 57 lbf/in (100 N/cm)

v. Operating Temperature: -20 to +70 degrees C (OFNR, OFCR) 0 to +70 degrees C (OFNP, OFCP)

2.04 FIBER OPTIC INTERCONNECT CABLE

A. Tight-Buffered fiber surrounded by aramid yarn strength members and flame-retardant jacket.

B. Cable Specifications

i. Fiber Count: Single or duplex type as required.

ii. National Electric Code OFNR designation.

iii. Crush Resistance: 20 lbf/in (35 N/cm)

iv. Operating Temperature: -20 to +70 degrees C

C. Fiber Specification Parameters

i. Required Fiber Grade - Maximum Individual Fiber Attenuation.

ii. Single-mode only: The maximum dispersion shall be no greater than 3.2 ps/(nm-km) from 1285 nm to 1330 nm and shall be less than 18 ps/(nm-km) at 1550 nm.

iii. The fiber manufacturer shall proof-test 100 percent of the optical fiber to a minimum load of 100 kpsi.

2.05 LOOSE TUBE FIBER OPTIC CABLE (INDOOR/OUTDOOR)

A. Cable shall be flame-retardant, UV stabilized, fully water blocked with the dielectric central member for use in indoor/outdoor applications. The buffer tubes shall be gel-free. Each buffer tube shall contain a water-swellable yarn for water-blocking protection. Cable manufacturers shall have a minimum of 20 years in manufacturing optical fiber cable to demonstrate reliable field performance. Cable and fiber manufacturers shall be the same company to ensure the long-term reliability of the cabled fiber and to ensure the availability of fully integrated technical support. The cable shall be suitable for installation in duct, aerial, and riser environments. The cable shall meet UL OFNR specifications and not require transition splicing upon building entry to meet fire codes.

B. Optical fibers shall be placed inside a buffer tube.

C. Each buffer tube shall contain up to 12 fibers.

D. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel-filling material. Colors shall not cause fibers to stick together.

E. Buffer tubes shall be kink-resistant within the specified minimum bend radius.

F. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.

G. The central anti-buckling member shall consist of a glass-reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.

H. The cable core shall contain a water-blocking material. The water-blocking material shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional non-toxic solvents. The cable shall contain water-blocking threads between tubes.

I. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

J. Tensile strength shall be provided by a combination of high-tensile-strength dielectric yarns.

K. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

L. All-dielectric cables (with no armoring) shall be sheathed with medium-density polyethylene (MDPE). The minimum normal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water-blocking material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

2.06 ARMOR JACKETED MULTI-FIBER CABLE

A. Rugged armored cable with polyethylene inner jacket, steel tape armor, and a medium density, water, and UV stabilized polyethylene outer jacket, suitable for duct or direct-buried installation. Cable shall be listed with Rural Utilities Service (RUS) 7 CFR 1755.900 and be fully compliant with ICEA S 87 640. Optional Nylon over jacket shall be available for resistance to hydrocarbons, including jet fuel, when required.

B. Cable Specifications

i. Fiber Count: as indicated.

ii. Maximum Tensile Load Short-Term: 600 lbf (2700 N)

iii. Maximum Tensile Load Long Term: 200 lbf (890 N)

iv. Minimum Crush Resistance: 125 lbf/in (220 N/cm)

v. Operating Temperature: -40 to +70 degrees, C

vi. Outside diameter: 1.03 inch (26.1 mm) (maximum)

C. The jacket or sheath shall be free of holes, splits, and blisters.

D. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

E. Cable jackets shall be marked with manufacturer's name, sequential meter or foot markings, the year of manufacture, and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be within "one percent of the length markings. The marking shall be in contrasting color with the cable jacket. The height of the marking shall be approximately 2.5 mm.

F. The maximum pulling tension shall be 2700 N (608 lbf) during installation (short-term) and 600 N (135 lbf) long-term installed.

G. The shipping, storage, and operating temperature range of the cable shall be minus 40 degrees C to plus 70 degrees C. The installation temperature range of the cable shall be minus 30 degrees C to plus 70 degrees C.

H. The cable shall be the FREEDM Series as manufactured by Corning Cable Systems, or equal.

I. CABLE CONSTRUCTION

i. Riser Cables

a. Riser cables up to 24 fibers: In cables with more than one fiber, the fibers shall be stranded around a dielectric member and surrounded by layered aramid yarns. The aramid yarns shall serve as the tensile strength member of the cable. A ripcord may be applied between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection.

b. Riser cables with more than 24 fibers: The buffered fibers shall be grouped into six fiber subunits. In each subunit, the individual fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. A ripcord shall be incorporated in the subunit design to facilitate access to the individual fibers. The subunit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

ii. Plenum Cables

a. Plenum cables up to 24 fibers: The fibers shall be stranded around a dielectric member and surrounded by layered aramid yarns. The aramid yarns shall serve as the tensile strength member of the cable. A ripcord may be applied between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection.

b. Plenum cables with 24 to 72 fibers: The buffered fibers shall be grouped into six fiber subunits. In each subunit, the individual fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. A ripcord shall be incorporated in the subunit design to facilitate access to the individual fibers. The subunit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

c. Plenum cables with more than 72 fibers: The buffered fibers shall be grouped into twelve fiber subunits. In each subunit, the individual fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. A ripcord shall be incorporated in the subunit design to facilitate access to the individual fibers. The subunit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

J. The strength member shall be a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarn to allow the yarns to be easily separated from the fibers and the jacket.

K. Cable Jacket

i. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.

ii. The cable and subunit jacket color shall be orange for cables containing multimode fibers.

iii. The cable and subunit jacket color shall be yellow for cables containing single-mode fibers.

iv. For cables with more than two fibers, the cable jacket shall be designed for easy removal without damage to the optical fibers by incorporating a ripcord under each cable jacket. Non-toxic, non-irritant talc shall be applied to the aramid yarns to allow the yarns to be easily separated from the fibers and the jacket.

v. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, low smoke, and environmental test requirements of this document over the life of the cable.

L. The cable shall be all-dielectric.

2.07 CABLE IDENTIFICATION

A. The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Color Coding of Fiber Optic Cables." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another. When fibers are grouped into individual units, each unit shall be numbered in the unit jacket for identification. The number shall be repeated at regular intervals.

B. The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet. The markings shall be in contrasting color to the cable jacket.

2.08 CABLE TESTING REQUIREMENTS

A. Fiber cables shall be tested in accordance with the following industry standard (EIA-455) tests:

i. FOTP-41, Compressive Loading Resistance Test.

ii. FOTP-104, Fiber Optic Cable Cyclic Flexing Test.

iii. FOTP-25, Repeated Impact Testing.

iv. FOTP-33, Fiber Optic Cable Tensile Loading and Bending Test.

v. FOTP-85, Fiber Optic Cable Twist Test.

vi. FOTP-181, Lightning Damage Susceptibility Test.

vii. FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fibers, Cables, and other Passive Fiber Optic Components.

viii. FOTP-82, Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable.

ix. FOTP-37, Low or High Temperature Bend Test for Fiber Optic Cable.

x. FOTP-98, External Freezing Test.

xi. FOTP-27, Fiber Diameter Measurements.

xii. FOTP-28, Measurement of Dynamic Tensile Strength.

xiii. FOTP-34, Interconnection Device Insertion Loss Test.

xiv. FOTP-89, Cable Jacket Elongation and Tensile Strength Test.

B. The Contractor shall submit laboratory test reports on representative samples of similar cable design to demonstrate compliance prior to cable installation.

2.09 FIBER CABLE TERMINATIONS, CONNECTORS, AND CABLE ASSEMBLIES

A. Pigtail Splicing

i. For termination of fiber cables at a termination or connector panel (patch panel), with one end of a piece of cable pre-connected and the other end unterminated for splicing to the cable that needs to be terminated. Splicing and connectors shall meet the requirements listed in this Section.

ii. A splice/termination tray shall house the splices and serve to fully protect excess lengths of loose tube fibers from exposure. The splice tray shall be compatible with the selected patch panel and installed for easy access to the spliced cable sections.

iii. Pigtail assemblies shall match fiber cable type and model and shall be manufactured by Corning Cable Systems or equal.

B. Buffer Tube Fan-Out Kits

i. Individual fibers within a loose tube cable with 250 µm coated fibers shall use a fan-out kit to maintain flexibility and ease of handling fibers within a termination cabinet. Fan-out kits shall be installed in the patch panel enclosures to transition the loose tube fibers to ruggedized tight-buffered fiber pigtail cables. Optical fusion splices shall connect the loose tube fibers to the tight-buffered pigtail cables. The optical splice loss shall comply with the specifications for optical splices. Splice protection sleeves shall be employed on all splices to protect the splices.

ii. The tight-buffered pigtails shall be factory pre-connected with STTM connectors as specified.

C. Connectors (Cable Assemblies)

i. The fiber optic communications system shall utilize stainless steel ST-style connectors for all fiber optic connections. SC-style connectors will be acceptable only if ST-style connectors are not compatible with the equipment being provided. The connectors shall be designed for use with 50/62.5/125/250-micron cables. Each connector shall cause a maximum signal attenuation of 1.6 dB.

ii. Factory-Installed Connectors: All cable assemblies shall have connectors installed at the factory. The connectors shall provide tight-fitting termination to the cladding and buffer coating. Epoxy-based or "hot melt "adhesives shall be used to bond the fiber and buffer to the connector ferrule and body prior to polishing the end face.

iii. Field-Installed Connectors: Type ST compatible, SC or LC design with ceramic or polymer ferrule and strain relief boot. The connector installation shall not require the use of epoxies, adhesives, or ovens. The connector shall be installable upon 900 µm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall contain a mechanical splice and have a tool kit available to aid in assembly. The installation tools used to terminate the connector shall be able to terminate other small-form-factor and single-fiber UniCam connector designs. The connector shall not require end-face polishing in the field. The connector shall have a factory polished optical fiber stub in the connector ferrule that is bonded in the ferrule micro hole. Ferrule material shall be available in ceramic or polymer. Connector specifications shall be as follows:

a. Insertion loss (typical): 0.3 dB

b. Durability (mating cycles): 500 (minimum)

c. Repeatability: Less than 0.2 dB

d. Operating Temperature: 0 to plus 60 degrees C

D. After termination with connectors, the fiber ends shall be visually inspected at a magnification of not less than 100 power for the multimode and 200x for the single mode to check for cracks or pits in the end face of the fiber.

E. Connectors shall have a maximum allowable connection loss of 0.3 dB per mated pair, as measured per EIA-455-34. No index-matching gel is to be used, dry interfaces only.

F. Each connector shall be of the industry standard ST type compatible; designed for single-mode and multimode tolerances; shall meet or exceed the applicable provisions of EIA-455-5, 455-2A, and 455-34; and shall be capable of 100 repeated ratings with a maximum loss increase of 0.1 dB. Connectors shall incorporate a key-way design and shall have a Zirconia ceramic ferrule. Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials such as nickel-plated zinc, designed to operate in humid environments without degradation of surface finishes. Connectors shall be capable of operating in a range of -40 to 80 degrees C.

G. Manufacturers

i. Corning Cable Systems, Hickory, NC

ii. AMP, Inc., Harrisburg, PA

iii. 3M Telecom Systems Group, Austin, TX or equal.

H. Fiber Optic Patch Cables

i. Fiber optic patch cable shall be two-fiber zipcord 50/62.5/125 core/clad micron multimode riser rated cable.

ii. Installation of patch cables shall include all spares and observe the minimum fiber bend radius and strain relief.

PART 3 EXECUTION

3.01 GENERAL

A. Provide all material, equipment, and labor to test and integrate the fiber optic system as indicated and as specified.

B. Installation shall comply with EIA/TIA Standards 568 and 569.

C. Fiber optic cables shall be continuous from component to component. Intermediate fiber splices shall not be allowed.

D. Provide delivery, storage, and handling of materials and equipment in accordance with Division 01.

3.02 IDENTIFICATION

A. Label each termination point.

B. Label each cable, buffer tube, and fiber with permanent waterproof typewritten tags.

3.03 PHYSICAL CHECKOUT

A. General Procedures

i. Conduct physical checkout of the fiber optic data highway network.

ii. Physical checkout shall be performed prior to functional testing.

B. Check Procedures

i. Verify that fiber optic cable reels have been off-loaded from truck carefully and not damaged.

ii. Submit to the Engineer all test data provided by the fiber manufacturer.

iii. Verify that the optical fibers of the cable assembly are the type and quantity as specified and as recommended by the Instrumentation System Supplier.

iv. Verify that cable construction is the type specified.

v. Verify that fiber optic patch panels have been installed plumb and level at locations indicated.

vi. Verify that optical fiber connections or terminations within patch panels and splice closures are in accordance with the cable manufacturer's recommendations.

3.04 FIBER OPTIC CABLE TESTING

A. General: The Contractor shall perform pre-installation and post-installation FOC tests. The Engineer shall be notified a minimum of 10 days in advance so that these tests are witnessed. All test equipment shall be traceable to NIST standards.

B. Test equipment: The Contractor shall use the following to perform pre-installation and post-installation FOC tests:

i. Optical time domain reflectometer (OTDR). The OTDR shall be laser precision and be able to test single-mode or multimode systems with a visual fault locator. The OTDR shall be manufactured by Corning, Agilent Technologies, Fluke Networks, or equal.

C. Pre-installation Tests

i. The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications; is free of defects, breaks, and damages by transportation and manufacturing processes; and to provide baseline readings in dB.

ii. Prior to the removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the Contractor using an OTDR. The OTDR tests shall consist of end-to-end length and fiber attenuation (dB/km) measurements to ensure proper performance of the fiber optic cable. The tests shall be performed from both ends of each fiber to ensure complete fiber continuity within the cable structure.

iii. Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the Contractor and manufacturer. In all cases, all fibers shall meet the optical attenuation specifications prior to cable installation.

iv. The Contractor shall perform tests on all reels of cable. The Engineer shall be notified a minimum of 15 days prior to any test.

v. The Contractor shall document each test and submit the report to the Engineer for review. Documentation shall consist of both hard copy and electronic file complete with all application software.

vi. Cable shall not be installed until the Engineer has reviewed the test report.

D. Post-installation tests: After FOC has been installed and connected, the following tests shall be performed:

i. Visually inspect terminal connectors for out-of-round condition and surface defects such as micro-chips and cracks using a 200X (minimum) inspection microscope.

ii. A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.

iii. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.

iv. A transmission test shall be performed with the use of a 1310 and 1550 nm stabilized light sources and 1310 nm/1550 nm power meters for SMF. This test shall be conducted in both directions on each fiber of each cable.

v. Hard and electronic copies of test documentation shall be submitted to the Engineer. The documentation shall include:

a. The trace plot.

b. Index.

c. dB/km loss.

d. Cable length.

e. Date and time of test.

f. Wavelength.

g. Pulse width.

h. The test site.

i. Cable ID.

j. Fiber number and type.

k. Operator's initials.

l. The Contractor shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the Engineer shall be notified in writing by the Contractor, and the cable shall be removed and replaced at no additional cost to the Owner.

vi. Upon completion of the previous tests, all FOC coils shall be secured with ends capped to prevent intrusion of dirt and water.

E. Certification of completion of pre- and post-fiber installation testing including test results shall be provided to the Engineer. Test results shall be submitted on paper in a binder, including results indicated in tables or a spreadsheet. Test results that exceed specification limits shall be noted. The electronic copy shall be included in the binder.

F. Required OTDR Trace Information

i. All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation-induced losses and/or connector losses). The trace shall display fiber length (in kilofeet), fiber loss (dB), and average fiber attenuation (in dB/km), as measured between two markers placed as near to the opposite ends of the fiber under test as is possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace, away from the front-end response and far-end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length the fiber under test.

ii. If connectors exist in the cable under test, then two traces shall be recorded. One trace shall record the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test, including connectors. The second trace shall display a magnified view of the connector regions, revealing the connector losses (dB). All connector losses shall be measured using the five-point splice loss measurement technique.

iii. The OTDR trace shall also include the following information:

a. The date and time of the test.

b. The cable ID number.

c. The cable segment ID number.

d. The fiber color or sub-cable number.

e. Launch point connector number.

f. The optical wavelength used for the test.

g. The refractive index setting of the OTDR.

h. The pulse width setting of the OTDR.

i. The averaging interval of the test.

3.05 TRAINING

A. Provide one half-day training on termination techniques and testing for up to three students prior to installation.

B. Provide training as soon as possible following submittal of proposed fiber optic cable.

3.06 WARRANTY

A. Refer to Section 40 61 13.

B. The Contractor shall provide an unconditional warranty on all installed cable for a minimum period of 20 years, commencing at the time of final acceptance by the Owner.

C. This Section describes the material and installation requirement for the fiber optic cabling system and associated equipment.

END OF SECTION

SECTION 40 67 00
PROCESS CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Refer to Section 40 61 13 Process Control System General Provisions.

B. Furnish and install control panels and panel-mounted equipment as specified herein and shown on the Drawings.

C. All components and wiring and construction methods shall be consistent across all the panels having the same equipment makes and models wherever possible, so that the system allows a cost-effective operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, the equipment furnished must be fully compatible.

D. Each panel shall be supplied with full sub-panels with the minimum specified dimensions regardless of the number of mounted components inside the panel. All panel-mounted components shall be mounted on the single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components shall only be permitted after review and approval of the Engineer.

E. Furnish the following panels.

Panel Designation	**Minimum Panel Size**	**Provided By**	**Enclosure Rating & Type**
Lift Station Local Control Panel	60” H X 48” W X 12” D	PCSS	NEMA Type 4X, 316 Stainless Steel, Wall mount, 3-point latch.
IT Room Server Rack	Refer to Section 40 62 00	PCSS	Refer to Section 40 62 00
Blower Control Panel	72” H X 72” W X 24” D	PCSS	NEMA Type 12, Painted Steel Enclosure, 3-point latch, with Floor Stand, with Compact Axial Fans

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 40 61 13.

1.03 RELATED WORK

A. Refer to Section 40 61 13 Process Control System General Provisions.

B. Electrical work not herein specified is included in Division 26. A 480 Volt, 3 Phase, 60 Hz, 3-wire power supply and field control and signal wiring will be provided under Division 26 to the control panel.

1.04 SUBMITTALS

A. Refer to Section 40 61 13 Process Control System General Provisions.

B. Descriptive literature, bulletins, catalog cuts, and drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. Panel Layout Drawings and Wiring Diagrams Submittal

i. Where direct hardwired interfaces exist between the PCSS control panels and supplier-provided control panels furnished under other Divisions, the Subcontractor shall provide to the PCSS the approved submittals in order for the PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be included in the Final O&M submittal. Leaving this information blank on the Final Documentation drawings is not acceptable.

ii. Panel Layout Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11 inches x 17 inches in size. At a minimum, the panel drawings shall include the following:

a. Interior and exterior panel elevation drawings to scale.

b. Nameplate schedule.

c. Conduit access locations.

d. Panel construction details.

e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.

f. Fabrication and painting specifications including color (or color samples).

g. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing with equipment located in hazardous areas.

h. For every control panel, heating and cooling calculations for each panel supplied indicate conformance with the cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.

i. Submit evidence that all control panels shall be constructed in conformance with UL 508/UL 698 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Subcontractor.

F. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections does not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA tag and a unique numeric identifier. The diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Owner/Engineer. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified, and power sources noted. Submit the final wire numbering scheme. Panel drawings shall be 11 inches x 17 inches in size.

G. ISA Loop Wiring Diagrams.

1.05 COORDINATION MEETINGS

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to 40 61 13 Process Control System General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to 40 61 13 Process Control System General Provisions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to 40 61 13 Process Control System General Provisions.

B. Package the control panel for maximum protection during delivery and storage.

C. Store the control panel indoors in a clean, dry, heated storage facility until ready for installation. Do not install the control panel in its final location until the facilities are permanently weathertight. Protect the control panel at all times from exposure to moisture, chemicals, hydrogen sulfide, and chlorine gas.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.10 MAINTENANCE

A. Refer to Section 40 61 13 Process Control System General Provisions.

B. Test Equipment:

i. Refer to Section 40 61 13 Process Control System General Provisions.

1.11 WARRANTY

A. Refer to Section 40 61 13 Process Control System General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to 40 61 13 Process Control System General Provisions.

2.02 LIGHTNING/SURGE PROTECTION

A. Refer to 40 61 13 Process Control System General Provisions.

2.03 CONTROL PANEL GENERAL REQUIREMENTS

A. The dimensions within this Section and on the Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

B. Each control panel and terminal cabinet shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses, and any other equipment necessary to achieve compliance with UL 508A/ UL-698A requirements. The drawings do not detail all UL 508A/ UL-698A requirements.

C. All enclosures shall have a lock installed in the door handle or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

D. The devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat-generating devices such as power supplies shall be located at or near the top of the panel.

E. The panels shall be completely fabricated, and instruments and devices installed and wired at the PCSS's facility.

F. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with the manufacturer's recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.

G. All exterior panel-mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel. Panels shall have the NEMA classification and materials of construction as specified in the Area Classification and Materials Schedule shown on the Drawings.

H. Nameplates

i. All panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).

ii. Unless escutcheon plates are specified or unless otherwise noted on the drawings, nameplates shall be 3/32-inch thick, black, and white, Lamicoid with engraved inscriptions. The letters shall be White against a Black background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

iii. Nameplate fasteners and mounting shall be epoxy adhesive or stainless-steel screws for cabinet-mounted nameplates

iv. For every panel, provide a panel nameplate with a minimum of 1-inch high letters. Provide legend plates or 1-inch by 3-inch engraved nameplates with ¼-inch lettering for identification of door-mounted control devices, pilot lights, and meters.

v. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.

I. Mounting Elevations

i. ISA Recommended Practice RP60.3 shall be used as a guide in the layout and arrangement of panels and panel-mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.

ii. Centerline of indicators and controllers shall be located 66 inches above the floor on a panel face.

iii. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32 inches or higher than 70 inches above the floor on a panel face.

iv. Tops of annunciators shall be located no higher than 86 inches above the floor on a panel face.

v. Installation of panel components shall conform to component manufacturers' guidelines.

2.04 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure

i. Panels shall be of continuous welded-steel or FRP construction as shown on the Panel Schedule. Panels shall have the NEMA classification and materials of construction as specified in the Area Classification and Materials Schedule shown on the Drawings. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

ii. Each panel shall be provided with full-height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch (except for NEMA 4X panels) and a heavy-duty stainless steel locking handle. Rear access doors (if included) shall be conveniently arranged and sized such that they extend no further than 24 inches beyond the panel when opened to the 90-degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full-length, continuous, piano-type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush-mounted instruments.

iii. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.

iv. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top-mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

v. All panels in indoor, dry, and non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet, and non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments shall be NEMA 4X unless otherwise noted. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1). Panels shall have the NEMA classification and materials of construction as specified in the Area Classification and Materials Schedule shown on the Drawings. Freestanding and Floor-Mounted Vertical Panels

vi. Freestanding and floor-mounted vertical panels shall meet the NEMA classification and materials of construction as specified in the Area Classification and Materials Schedule shown on the Drawings and as specified herein. The panels shall be constructed of 12-gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of Type 316 stainless steel unless FRP is specifically indicated to be provided. Front panels or panels containing instruments shall be not less than 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

B. Wall and Unistrut Mounted Panels

i. All wall and Unistrut mounted panels shall meet the NEMA classification and materials of construction as specified in the Area Classification and Materials Schedule shown on the Drawings and as specified herein. The panels shall be constructed of not less than USS 14-gauge steel, suitably braced internally for structural rigidity and strength. All NEMA 4X-rated wall-mounted panels shall be constructed of Type 316 stainless steel unless FRP is specifically indicated. FRP panels shall be used in certain chemical areas as given here. All FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.

C. Finish Requirements

i. All sections shall be descaled, degreased, filled, ground, and finished. The enclosure when fabricated of steel shall be finished with two rust-resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

ii. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

iii. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sand-ing shall be applied to the intermediate exterior coat before top coating.

iv. Apply a minimum of two coats of the manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.

v. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.

D. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded onto the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all the prints required to service the equipment and to accommodate 8.5-inch by 11-inch documents without folding.

E. Where specified on the Panel Schedule, a folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. The shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. The folded shelf shall not interfere with any internal panel components when the door is closed. The folding shelf shall automatically lock in the horizontal position when raised. The folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. All parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

2.05 ENVIRONMENTAL CONTROL

A. All panels shall be provided with sun shields, heat sinks, or air conditioning units as required to limit temperature buildup inside of the panel. The internal temperature of all panels shall be regulated to a range of 45°F to 104°F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.

B. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, an air conditioner shall be provided.

C. Provide custom-fabricated sun shields for all outdoor panels in accordance with the following requirements:

i. Sun shields shall be fabricated from a minimum of 12-gauge Type 316 stainless steel. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.

ii. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free-standing framing around the enclosure.

iii. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs too, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.

iv. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall-mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free-standing, floor-mounted, and frame-mounted enclosures the top section shall slope downward toward the back side of the enclosure.

v. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.

vi. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.

vii. All exposed corners, edges, and projections shall be smoothly rounded or chamfered to prevent injury.

D. All outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount the unit near the bottom of the enclosure with discharge away from heat-sensitive equipment. The heater shall be Hoffman DAH or equal. Heater wattage shall be as required for the control panel in which it is mounted. Provide calculations in the control panel submittal to indicate proper sizing.

2.06 CORROSION CONTROL

A. Panels shall be protected from internal corrosion using corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.

2.07 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

i. All interconnecting wiring shall be stranded, type MTW, shall have 600-volt insulation, and be rated for not less than 90°C. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

ii. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cables insulated for not less than 600 volts.

iii. Each panel shall be provided with a circuit breaker to interrupt incoming power.

iv. Each control panel shall have a separate power distribution circuit with a circuit breaker, for UPS power and normal power. All microprocessor-based equipment and instruments shall be powered from the UPS source.

v. Provide surge protectors on all incoming power supply lines at each panel per the requirements of 40 61 13 Process Control System General Provisions.

vi. All panels shall be designed with protective barriers around voltage sources, such that risk from arc flash is eliminated and personal protective equipment is not required to enter the panel.

vii. Power and low voltage DC wiring systems shall be routed in separate wire ways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6 inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 % visible fill.

viii. Wiring trough for supporting internal wiring shall be plastic-type with snap-on covers. The side walls shall be the open-top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

ix. All wiring shall be clearly tagged and color-coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings prepared by the PCSS. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color-coding scheme shall be in accordance with UL 508A/UL 698A Standards.

a. Black – all ungrounded control circuit conductors operating at the supply voltage.

b. Red – ungrounded ac control circuits operating at a voltage less than the supply voltage.

c. Blue – ungrounded dc control circuits.

d. Yellow – ungrounded control circuits or other wiring, such as for cabinet lighting, that remain energized when the main disconnect is in the "OFF" position.

e. White or natural gray – grounded ac current-carrying control circuit conductor regardless of voltage.

f. White with blue stripe – grounded dc current-carrying control circuit conductor.

g. White with yellow stripe – grounded ac control circuit current-carrying conductor that remains energized when the main disconnect switch is in the "OFF" position.

x. All wiring to hand switches and other devices that are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified as such.

xi. Each panel shall have control, signal, and communication line surge suppression in accordance with 40 61 13 Process Control System General Provisions.

xii. Terminations

a. All wiring shall terminate onto single-tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.

b. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 % spares.

c. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 40. The terminal block shall be Allen Bradley or Phoenix contact.

d. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments.

e. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the cabinet.

f. Wire and tube markers shall be the sleeve type with heat-impressed letters and numbers.

g. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6 inches of the side panel or adjacent terminal or within 8 inches of the bottom of free-standing panels, or within 3 inches of stanchion-mounted panels or 3 inches of adjacent wire way.

h. Circuit power from the control panel cabinet out to field devices (switches, dry contacts, etc.) that are used as discrete inputs to the microprocessor input cards shall be isolated with an isolating switch terminal block with a flip cover supplied with a dummy fuse. The isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.

i. All discrete and analog inputs and outputs to the field shall be protected with individual isolating fuse switch terminal blocks, complete with flip covers and blown fuse light indicators. The single circuit fusible terminal block shall be an Allen Bradley 1492-H4 or equal.

j. All discrete outputs shall be wired to interposing relays powered separately from the module.

k. All analog inputs and outputs to field devices shall be protected with panel-side surge suppressors as required in Section 40 61 13 Process Control System General Provisions.

l. All active and spare and controller points shall be wired out to field terminal blocks and protected in the manner described herein.

xiii. Each panel shall have an LED light fixture, 20 watts in size, with a door automatic activate switch, mounted internally to the ceiling of the panel.

xiv. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. The convenience receptacle shall be powered from the normal power source, not the UPS power source, and shall be protected by a dedicated fuse or circuit breaker.

xv. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

xvi. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

xvii. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 26.

B. Pneumatic Tubing

i. Refer to Section 40 61 13 Process Control System General Provisions.

ii. Pneumatic tubing shall be a minimum of ¼-inch O.D. Type 316 stainless steel with compression fittings. All tubing shall be rigidly supported and run in horizontal or vertical planes.

iii. All pneumatic equipment shall be provided with separate shut-off valves. Flexible polyethylene tubing shall be used on all devices mounted on hinged doors, etc.

iv. A screened vent shall be provided on all enclosures using pneumatic instruments.

v. All pneumatic tubing shall be routed in separate bundles or wire ways and shall be separated from all electrical wiring by a minimum of 3 inches.

C. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26, or shown on the Drawings shall be provided under this Section.

2.08 ELECTRICAL COMPONENTS

A. Main circuit breaker shall be a thermal-magnetic molded case breaker, by Square D Company, or equal. Provide a flange-mounted main power disconnect operating handle with a mechanical interlock having a bypass that will allow the panel door to open only when the switch is in the OFF position.

B. A mechanical disconnect mechanism, with a bypass, shall be installed on each motor circuit protector, capable of being locked in the "OFF" position to provide a means of disconnecting power to the motor.

C. Auxiliary contacts shall be provided for remote run indication and an indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical equipment requirements, the P&IDs (Division 40, the Control Wiring Diagrams (Division 26), and as shown on the Drawings.

D. Operating control devices and instruments shall be securely mounted on the exterior door. Controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Contract Drawings.

E. A six-digit, non-resettable quartz time base elapsed time meter shall be connected to each motor starter. The meter shall be Hobbs 98000 Series, Redington Model 722, Cramer Model ETI-635 G, or equal.

F. Control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or equal.

G. Where required by Specifications, an alternator shall be provided to sequence motors. The alternator shall be Catalog No. 008-120-13SP or 009-120-23AP by Stacon; Square D, Class 9039, Type HG-21 or equal.

H. Panel-mounted timers shall be flush mounted, plug-in type, Eagle Signal Bulletin 125 cycle-flex, Idec SR6P-MO8G or equal, with ranges as shown on the Drawings, or as required by the detailed mechanical equipment specifications.

I. Specific control devices, control descriptions, and other data are specified under the detailed specification for the mechanical equipment with which the control panel is supplied.

2.09 PILOT TYPE INDICATING LIGHTS

A. Type: 30mm energy efficient, push-to-test, Solid State LED Lamps.

B. Functional:

i. Units shall be provided with low-voltage LED lamps suitable for the voltage supplied.

ii. Lights supplied with 120V AC power shall have integral reduced voltage transformers.

iii. Lamps shall be replaceable from the front of the unit.

iv. Lamps shall be "Push to Test".

C. Physical:

D. Lens color:

i. Run, On, Open - Green.

ii. Stop, Off, Closed - Red.

iii. Alarm - Amber.

iv. Provide legend faceplates engraved to indicate the required function of each device; NEMA rating - 4X.

v. Energized – Red (at Motor Control Centers and Adjustable Speed Drives only)

E. Manufacturer(s):

i. Cutler-Hammer.

ii. Allen Bradley.

iii. General Electric.

iv. Square D.

v. Crouse Hinds (NEMA 7).

2.10 SELECTOR SWITCHES AND PUSHBUTTONS

A. Type:

i. Control devices shall be 30mm heavy-duty oil tight type with stackable contact blocks.

B. Functional:

i. Provide contact arrangement and switching action as required for the control system specified.

C. Physical:

i. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide silver sliding contacts rated 5 amps at 125 VDC, for electronic (millivolt/milliamp) switching provide contacts rated lamp at 28 VDC.

ii. Pushbuttons shall have flush type operators. EMERGENCY STOP (E-STOP) shall have mushroom head.

iii. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

iv. Button color shall be red for STOP and E-STOP, green for START, and black for RESET.

D. Manufacturer(s):

i. Cutler-Hammer.

ii. Allen Bradley.

iii. General Electric.

iv. Square D.

V. Crouse Hinds (NEMA 7).

2.11 POTENTIOMETER

A. Type:

i. Device shall be heavy-duty 30 mm oil tight type.

B. Functional:

i. 270-degree dial

ii. Rated for 1,000 ohms.

C. Physical:

i. Mounting: Suitable for panel mounting

ii. NEMA 4X rating; escutcheon plates scaled in engineering units.

D. Manufacturer(s):

i. Allen Bradley Co.

ii. Cutler-Hammer.

iii. Square D.

iv. Or equal.

2.12 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Type:

i. General purpose plug-in type, with internal indicator and DPDT.

B. Functional:

i. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.

ii. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.

iii. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.

iv. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

C. Physical:

i. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.

D. Options/Accessories Required:

i. Provide mounting sockets with pressure type terminal blocks rated 300 volts and 10 amps.

ii. Provide mounting rails/holders as required.

E. Manufacturer(s):

i. Allen Bradley.

ii. IDEC.

iii. Potter & Brumfield.

iv. Or equal.

2.13 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Type:

i. Solid state, ASIC technology, electronic type.

B. Functional:

i. Input: 4-20 mA.

ii. Output: Isolated contact output, double pole double throw, rated 5 amps at 120 VAC.

iii. Accuracy: 0.1 %.

iv. Protection: Provide RFI protection.

v. Deadband: Adjustable between 0.1 and 5.0 % of span.

vi. Set point Adjustment: Single Point alarms shall be adjustable to trip on rising or falling input signal, dual point alarms shall be adjustable to trip on rising and falling input signals.

vii. Repeatability: Trip point repeatability shall be at least 0.1 % of span.

C. Physical:

i. Mounting: DIN rail.

D. Manufacturer(s):

i. Action Instruments Slim Pak.

ii. Phoenix Contact.

iii. Acromag.

iv. Or equal.

2.14 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Type:

i. Solid state, ASIC technology; electronic type.

B. Functional:

i. Accuracy: 0.15 %.

ii. Inputs: Current, voltage, frequency, temperature, or resistance as required.

iii. Outputs: Current or voltage as required.

iv. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.

v. Adjustments: Zero and span adjustment shall be provided.

vi. Protection: Provide RFI protection.

C. Physical:

i. Mounting: DIN Rail.

D. Manufacturer(s):

i. Action Instruments Slim Pak.

ii. Phoenix Contact.

iii. Acromag.

iv. Or equal.

2.15 SIGNAL SELECTORS, COMPUTATION, AND CONDITIONING RELAYS

A. Type:

i. Solid state, ASIC technology, electronic type.

B. Functional:

i. Inputs: 4-20 mA.

ii. Outputs: 4-20 mA.

iii. Protection: Provide RFI protection.

iv. Operation: The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/ computation function required. All inputs shall be able to be individually rescaled and biased as required.

v. Isolation: All inputs, outputs, and power supplies shall be completely isolated.

vi. Accuracy: 0.35 % of span.

vii. Adjustments: Multi turn potentiometer for zero, span, scaling, and biasing.

C. Physical:

i. Mounting: DIN rail.

D. Manufacturer(s):

i. Action Instruments Slim Pak.

ii. Phoenix Contact.

iii. Acromag.

iv. Or equal.

2.16 INTRINSIC SAFETY BARRIERS

A. Type:

B. Barriers shall be of the solid-state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

C. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.

D. Options Required:

i. Barriers shall match power supply provided.

ii. Barriers shall be located in non-hazardous areas.

E. Manufacturer(s):

i. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts)

ii. Gems – 54800 (4-20mA) and 65800 (dry contacts)

iii. R. Stahl - Intrinspak

iv. Or equal.

2.17 EMERGENCY ALARM BEACON AND AUDIBLE HORN

A. Beacon alarm light:

i. Type:

a. Beacon alarm light.

ii. Physical:

a. Beacon alarm light for building exterior mounting shall be 120 VAC, flush mounted, weatherproof construction.

b. A 750,000-candle power xenon strobe tube and red polycarbonate lens.

iii. Manufacturer(s):

a. Federal Signal.

b. Square D.

c. Edwards.

d. Wheelock.

e. Or equal.

B. Alarm Horn:

i. Type:

a. Alarm horn shall be vibrating type for 120 Volts, 60 Hz.

ii. Manufacturer(s):

a. Federal Signal Corp.

b. Square D.

c. Edwards Co.

d. Benjamin.

e. Or equal.

2.18 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

i. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.

ii. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

iii. Manufacturer(s):

a. P&F.

b. Gems.

c. Unitech.

d. Or equal.

2.19 24 VDC POWER SUPPLIES

i. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.

ii. The 24 VDC power supply shall meet the following requirements:

a. Input power: 115 VAC, +/- 10 %, 60 Hz.

b. Output voltage: 24 VDC.

c. Output voltage adjustment: 5 %.

d. Line regulation: 0.05 % for 10-volt line change.

e. Load regulation: 0.15 % no load to full load.

f. Ripple: 3 mV RMS.

g. Operating temperature: 32° to 140°F.

iii. Size the 24 VDC power supply to accommodate the design load plus a minimum 25% spare capacity.

iv. If power supply on/off status signal is shown, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.

v. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

vi. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

vii. Manufacturer(s):

a. Acopian.

b. Phoenix Contact.

c. Lambda.

d. Or equal.

2.20 DIGITAL PANEL METER

A. Type:

i. Electronic, 3.5-digit, 0.56-inch high efficiency LED display.

B. Operation:

i. To accept 4-20 mA DC input signal and provide indication in engineering units of measured variable.

C. Functional:

i. Accuracy: +/-0.25% of calibrated range.

ii. Power supply: 115 VAC, +/- 10 %, 50/60 Hz, 10 VA.

iii. Indication: 0.56-inch LED display.

iv. Operating Temperature: -20° to 70°C.

v. Input: 4 to 20 mA.

vi. Output: retransmitted 4 to 20 mA.

vii. Digital Outputs: 2 Form C programmable contacts rated for 5A at 120/240 VAC.

viii. Display: 5-digit LED display.

ix. Indicator Failure: Failure of the indicator will not cause failure of the 4-20 mA loop.

D. Physical:

i. Case size nominal 2.5-inch high by 5-inch wide by 6-inch deep.

ii. Case type: watertight and dust-tight (NEMA 4X) and explosion-proof approved for Class I, Division 1, Groups C and D areas.

iii. Mounting: flush panel suitable for high density mounting arrangements.

iv. Programmable via integrated keypad.

E. Performance: Linear input accuracy +/- 0.05 % of calibrated span, +/- 1 count.

F. Manufacturer(s):

i. Precision Digital.

ii. Red Lion Controls PAXDP Series.

iii. Or equal.

2.21 SPARE PARTS

A. General requirements for spare parts are specified in Section 40 61 13 Process Control System General Provisions.

B. The following control panel spare parts shall be furnished:

i. Timers and sockets – (2) of each type installed.

ii. Relays and sockets – (2) of each type installed.

iii. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed.

iv. Light bulbs - 10% (minimum of 10) of each type installed. For LED type lights, 5% (minimum of 3) of each color installed.

v. (5) of each color replacement lens caps for pilot lights.

vi. Panel Mounted power supplies - one of each type installed.

vii. Selector switches/pushbuttons - Two of each type installed including contact blocks.

viii. Provide touch-up paint, of each type and color used for all cabinets, panels, and consoles supplied.

ix. (1) starter coil for each NEMA size furnished.

x. (1) 3-pole set of replacement overload heaters of each size range used.

xi. (1) 3-pole set of starter contacts of each NEMA size used.

C. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturer's name, description, and part number on the exterior of the package.

PART 3 EXECUTION

3.01 INSTALLATION

A. The panels shall be installed at locations as shown on the Contract Drawings.

B. Refer to Section 40 61 13 Process Control System General Provisions.

3.02 TESTING

A. Refer to Section 40 61 13 Process Control System General Provisions and Section 40 61 21 Process Control System Testing.

END OF SECTION

SECTION 40 67 63
CONTROL PANEL-MOUNTED UNINTERRUPTIBLE POWER SUPPLY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor and equipment, including supervision and materials for the installation, testing, startup, and training for the uninterruptible power supply (UPS) as specified herein.

B. Refer to plan drawings for control panels and racks requiring a UPS.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 40 61 13.

1.03 RELATED WORK

A. Section 26 - Electrical.

1.04 SUBMITTALS

A. Submittals shall be in accordance with Div 01 – Submittal Procedures and 40 61 13 Process Control System General Provisions. Submittals shall include shop drawings and product data, for the following:

i. Product brochure.

ii. Bill of materials listing all components provided.

iii. Deviation list indicating all proposed exceptions.

iv. Power single line and control schematics drawings. All external connection details and their terminal block locations shall be fully detailed. All internal wiring shall include terminal numbers and color coding.

v. UPS performance specifications:

a. kVA rating.

b. Input and output voltage and phase.

c. Run time at full and half load.

d. Voltage (output regulation, input tolerance, unbalance, transfer/retransfer voltage, etc.).

e. Heat rejection.

vi. Operating Instruction manuals and recommended replacement parts.

vii. Name, address, and telephone number of the nearest service facility.

viii. Training agenda and information per Section 01735 – Vendor Training.

ix. Battery specifications and warranty.

x. UPS Loading and battery sizing calculations to support runtimes as specified herein.

1.05 REFERENCE STANDARDS

A. ANSI C62.41/IEEE 587 - Standards for Surge Withstand ability.

B. FCC (Federal Communications Commission) Rules and Regulations, Part 15, Subpart B, Class A certified compliance.

C. UL (Underwriters Laboratories) 1778 Listed (Rev. Jan 5, 2000), UL497A

D. CSA 22.2, No. 107.1 M95 AND 107.2.

E. IEC 62040-2 Emission and Immunity.

F. IEC 62040-3 (Uninterruptible Power Systems, Part 3).

G. EN 60529 Equipment Protection.

H. National Electric Code (NFPA-70).

I. ISO 9001.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide delivery, storage, and handling in accordance with Division 01 and per the following:

1. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install, and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Always protect the equipment from exposure to moisture and chemicals.

1.07 QUALITY ASSURANCE

A. UPS systems shall utilize a field-proven design. The UPS manufacturer shall demonstrate at least ten years of continuous field operating experience with equipment of similar size and design.

B. A factory-authorized service and parts organization shall be located within 100 miles of the project location. Submit the name and address of the factory-authorized service and parts organization. The manufacturer shall have a complete selection of service options that may include onsite service by factory-employed service engineers and factory depot quick-return service plan options.

C. Equipment shall be UL or ETL labeled.

D. The UPS manufacturer shall have ISO 9001 certification.

E. The UPS system shall meet or exceed the theoretical Mean-Time-Between-Failures (MTBF) for a Single module UPS operation (represents UPS module operation only) of 140,000 MTBF hours.

1.08 WARRANTY

A. Refer to Division 01 - Closeout Procedures.

B. UPS: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the UPS for a period of one year from the date of purchase. The Subcontractor shall provide an additional one-year extended warranty to cover delays associated with equipment startup or date of receipt by the end-user, whichever occurs first.

C. Battery: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the batteries for a period of one year from the date of purchase. The Subcontractor shall provide an additional one-year extended warranty to cover delays associated with equipment startup or date of receipt by the end-user, whichever occurs first.

PART 2 PRODUCTS

2.01 SINGLE-PHASE UPS - EXTERNAL TO CONTROL PANEL

A. General:

i. Provide a continuous duty, online, solid state, double conversion, single-phase input, single-phase 120VAC true sinewave output uninterruptible power system.

ii. The UPS shall provide power conditioning and power backup for SCADA and Communication server racks, and other critical electronic loads.

iii. The UPS system shall consist of the following major components:

a. Rectifier and battery charger.

b. Inverter.

c. Batteries and battery disconnect switch.

d. Automatic static bypass switch.

e. External maintenance bypass switch.

f. Integral control and monitoring panel.

iv. The UPS shall be manufactured by one of the following:

a. Allen Bradley 1609-P Industrial Tower UPS with Rack mounting option

b. Schneider Electric APC Smart-UPS.

c. Or equal.

B. General Requirements:

i. External Battery Enclosure: A separate enclosure shall be provided for housing additional batteries if required to provide the minimum run time as specified herein. The battery enclosure shall match the main UPS enclosure in style and color.

ii. All cabling required to interconnect all components of the UPS system shall be provided by the UPS manufacturer.

iii. Battery protection shall be provided with an internal circuit breaker disconnect. Battery cabinets shall be protected by an internal circuit breaker.

iv. Current limiting circuitry shall protect the inverter output under any load condition. High-speed semiconductor fusing shall protect the static bypass in the event of an output short circuit.

v. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for the installation of a bonding connector shall be provided.

C. Performance Requirements – Ratings:

i. Battery runtime: Provide batteries to support 125% of the calculated load for 30 minutes. Provide additional batteries in separate enclosure as required to meet the runtime requirement.

ii. Output power: Size the UPS to provide the minimum recommended kVA ratings for the following UPSs in order to supply the control panels and ancillary equipment shown on the Control System Architecture Diagram and provide the required Battery run time. Confirm UPS ratings below per UPS submitted load calculations, spare capacity, and runtime requirements as specified herein.

D. Performance Requirements -Environment:

i. Ambient temperature: 0° to 40°C.

ii. Elevation: Project site elevation.

iii. Relative humidity: 0 to 95 percent non-condensing.

E. Electrical Requirements:

i. System Input – Primary source:

a. Dual input: 120 V AC

b. Frequency: 60 Hertz plus or minus five percent.

c. Input Power Factor: 0.96 lag minimum, 50 to 100 percent load.

d. Input Current Total Harmonic Distortion (THD): <33 percent.

e. Input Surge Withstand ability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).

f. Input Connection: Coordinate with electrical Subcontractor.

ii. System Output:

a. Nominal Output Voltage: 120 V AC.

b. Frequency: 60 Hertz plus or minus 3 Hertz.

c. 100 percent load with 3:1 Crest Ratio

d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)

e. Output Connections: (six) NEMA 5-15R receptacles.

iii. AC to AC Efficiency: (100 percent load @ rated PF): 91 percent

iv. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25°C (77°F) and full load.

v. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart B, for Class A devices.

F. Modes of Operation:

i. Normal Mode: The UPS shall be a continuous online unit. Power to the critical loads shall be continuously generated by the inverter during normal AC line power. In the event of AC line power failure, power to the inverter is supplied by the batteries. Under normal operation, the batteries shall be charged in a manner that optimizes battery life. A simple "trickle charge" of the batteries shall not be acceptable.

ii. Bypass Mode: The automatic bypass shall transfer the critical load to the commercial AC source, bypassing the UPS inverter/rectifier, in the case of an overload, load fault, or internal failure.

iii. Maintenance Mode: The external manual bypass switch shall be operated to transfer the load to the alternate source when the UPS is taken out of service for maintenance or repair. This transfer shall occur without interruption.

G. Controls:

i. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided using a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. The startup, battery charging, and transfers shall be automatic functions.

ii. Graphical Display: The UPS control panel shall utilize an LED graphical display for all UPS control, monitoring, alarming, configuration, and diagnostic functions. The following operational controls and indicators shall be provided on the UPS control panel per the following KVA ranges:

a. LED graphical UPS indications:

1) UPS On/Alarm Silence/Manual Battery Test control.

2) Standby/Manual Bypass control.

3) LED Battery Meter.

4) Battery in operation status.

5) Load on Inverter status.

6) Load on By-Pass status.

7) AC input status.

8) UPS malfunction alarm.

iii. Provide software tools that provide safe system shutdown in the event of an extended power outage or computer power problem, preventing potential data corruption.

H. UPS monitoring and status indication: Provide ethernet card to communicate the UPS with the SCADA system, as a minimum, the following monitoring and alarm and status conditions:

i. UPS Normal (UPS is using utility power to power the load and detects no faults).

ii. UPS in Static bypass mode.

iii. UPS using battery to power the load.

iv. UPS on battery and battery low.

v. Battery Charge level.

vi. Battery Estimated Time.

vii. Battery Capacity.

viii. Battery temperature.

ix. Battery Voltage.

x. Input/Output Voltage.

xi. Input/ Output Current.

xii. Input/Output Frequency.

I. Rectifier/charger:

i. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

J. Inverter:

i. The inverter shall include all solid-state equipment and controls to convert DC power from the rectifier/charger or battery to regulated AC power for powering the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse-width modulated (PWM) design capable of providing the specified AC output.

ii. The inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. The inverter is to provide 150 percent of the full load for 30 seconds and 125 percent of the full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

iii. The output voltage shall be maintained to within plus or minus 4 percent.

iv. The output voltage total harmonic distortion (THD) shall not be greater than 5 percent for all loads. For a 100 percent rated load of 3:1 crest factor nonlinear loads, the output voltage total harmonic distortion shall not be greater than 4 percent. The output rating shall not be derated in kVA or kW due to the 100 percent nonlinear load with a 3:1 crest factor.

v. The inverter shall use software control to adjust the output voltage from plus or minus 5 percent of the nominal value.

K. Batteries:

i. The batteries shall be VRLA (valve-regulated lead-acid), sealed, maintenance-free, high-rate discharge, and lead-acid cells suitable for use indoors with no off-gassing or water addition requirements. Batteries shall not require special ventilation. The battery shall consist of one or more battery banks with the number of cells required to meet the requirements of the rest of this Specification.

ii. Two-year battery design life.

iii. Run time operation of the UPS shall be accomplished using batteries mounted within the UPS enclosure and supplemented as required with an external battery enclosure to provide the battery runtime specified.

L. External maintenance bypass:

i. Each UPS shall be provided with a "two-position" external bypass switch system to permit the UPS to be removed for repair or maintenance without causing power disruption to the connected power loads. The external bypass switch shall be the snap-action type with a switching speed of approximately 10ms or less independent of operator action. External bypass switch positions shall be labeled UPS and UTILITY.

ii. Provide a dry contact to indicate when the bypass switch is in the “Maintenance” position. Contact shall be rated for 250VAC @ 5A or 30VDC @ 5A.

iii. For UPS units below 3kVA provide standalone switches, such as Electroswitch series 103 snap action switches (or equal), along with custom plugs, receptacles, and appropriate wiring to achieve the specified functionality.

iv. PCSS may elect to use the UPS manufacturers' maintenance bypass switch if it provides the desired functionality and dry contact.

v. For UPS units above 3 kVA, substitute standard manufacturers' Maintenance Bypass switch offerings or standalone switches as indicated above.

M. Enclosures:

i. All UPS equipment shall be housed in a free-standing NEMA 1 enclosure(s). The enclosures shall line up and match in style and appearance.

2.02 SINGLE-PHASE UPS - INTERNAL TO CONTROL PANELS

A. General:

i. Provide an industrially rated continuous duty, online, solid state, line-interactive, single-phase uninterruptible power system with pure sinewave output.

ii. The UPS shall provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads including UPS-powered instruments as shown on drawings.

iii. The UPS system shall consist of the following major components:

a. Rectifier and battery charger.

b. Inverter.

c. Batteries.

iv. The UPS shall be:

a. Allen Bradley 1609-D UPS.

b. Phoenix Contact QUINT AC UPS.

c. Or equal.

B. General requirements:

i. Battery protection shall be provided with an internal circuit breaker disconnect.

ii. Current limiting circuitry shall protect the inverter output under any load condition.

iii. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for the installation of a bonding connector shall be provided.

iv. The UPS shall be suitable for installation in a UL508A listed panel.

v. The UPS shall be DIN rail mountable.

vi. UL recognized components for industrial applications in accordance with UL508 without derating.

C. Performance requirements:

i. Ratings:

a. Output power: Size the UPS to provide between 350VA – 1500VA according to the load to be served.

b. Battery runtime: 15 minutes at 125% of the calculated load, 30 minutes at half-load.

ii. Environment:

a. Ambient temperature: 0° to 40°C.

b. Elevation: Up to 500 feet above mean sea level.

c. Relative humidity: 1 to 95 percent non-condensing.

iii. System Input – Primary source:

a. Dual input: Nominal Input Voltage: 120 VAC.

b. Frequency: 45 to 65 Hz.

c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.

d. Input Surge Withstand ability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).

iv. System Output:

a. Nominal Output Voltage:120 VAC.

b. Frequency: 60 Hertz plus or minus 3 Hertz.

c. 100 percent load with 3:1 Crest Ratio.

d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)

v. AC to AC Efficiency: (100 percent load @ rated PF): 88 percent online, 86 percent on battery.

vi. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25°C (77°F) and full load.

vii. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

D. Modes of operation:

i. The UPS shall operate as a line interactive online, fully automatic system in the following modes:

a. Normal: The critical load shall be continuously supplied with filtered and regulated AC power by the inverter. The rectifier/battery chargers shall derive power from the preferred AC source and supply DC power to the inverter while simultaneously floats charging the batteries.

b. Emergency: Upon failure of the preferred ac power source, the critical load shall continue to be supplied by the inverter. Inverter power shall be supplied without switching from the storage battery. There shall be no interruption to the critical load upon failure or restoration of the preferred ac sources. If the AC source cannot be restored before the battery discharges to its low voltage dropout value, the UPS shall automatically shut itself down in an orderly manner.

c. Recharge: Upon restoration of the AC source, the rectifier/battery charger shall power the inverter and simultaneously recharges the batteries. This shall be an automatic function causing no interruption to the critical load.

E. Rectifier/charger:

i. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

F. Inverter:

i. The inverter shall include all solid-state equipment and controls to convert DC power from the rectifier/charger or battery to regulated AC power for powering the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse-width modulated (PWM) design capable of providing the specified AC output.

ii. The inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. The inverter is to provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation.

iii. The output voltage shall be maintained to within plus or minus 5 percent.

iv. The output voltage total harmonic distortion (THD) shall not be greater than 5 percent at full load.

G. Batteries:

i. The batteries shall be High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off-gassing, or water addition requirements. Batteries shall not require special ventilation. The battery shall consist of one or more battery banks with the number of cells required to meet the requirements of the rest of this Specification.

ii. Two-year battery design life.

H. Controls and monitoring:

i. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided using a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.

ii. Front Indicators: As a minimum, the following indicators shall be provided on the UPS control panel:

a. On-line (UPS is using utility power to power the load).

b. In bypass mode.

c. On battery.

d. Overload.

e. Replace battery / battery disconnected.

f. Fault.

g. Bar graph for utility voltage.

h. Bar graph for battery.

iii. Front Panel Controls: As a minimum, the following controls shall be provided on the UPS control panel.

a. Power On/Off.

b. Self-test.

c. Alarm silence.

d. Cold start.

e. Load off.

iv. Remote alarm and status indication: Isolated SPDT dry contacts shall be provided and connected to the PLC /RIOs to indicate UPS status for remote monitoring. Contacts shall be rated for 250VAC @ 5A or 30VDC @ 5A Individual contacts shall be provided for separate annunciation of the following alarm and status conditions:

a. UPS Fail.

b. Battery Alarm.

c. UPS in Line.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and connect the equipment in accordance with the manufacturer's instructions.

B. Remove temporary lifting angles, lugs, and shipping braces.

C. Touch up damaged paint finishes.

3.02 FACTORY TESTING

A. Prior to shipment, the complete UPS system shall undergo the manufacturer's standard factory test.

3.03 FIELD TESTING

A. Perform the following minimum test and checks:

i. Verify that all connections are completed in accordance with shop drawings.

ii. Verify supply voltage and phase sequence are correct.

iii. Check mechanical interlocks for proper operation.

iv. Test ground connections for continuity and resistance.

v. Check control circuit interlocking and continuity.

B. Submit the test plan for review and approval.

C. For UPSs rated 3-6kVA, the manufacturer's field service technician shall perform startup and adjustment of the UPS in accordance with the manufacturer's written instructions. Submit a copy of the field report containing verification of all startup tests and adjustments performed.

D. The Subcontractor shall include testing of battery runtime under full load with loss of AC power.

E. Perform all additional tests required by Section 16105 - Acceptance Testing of Electrical Systems.

F. In the event of an equipment fault, notify the Engineer/Owner immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Subcontractor, the Engineer/Owner and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Engineer/Owner.

3.04 ADJUSTMENT

A. Make all UPS adjustments necessary for manual and automatic operation of the entire system.

3.05 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.06 TRAINING

A. Provide training of staff in accordance with Division 01 – Vendor Training and Section 40 61 26 Process Control Training.

END OF SECTION

40 70 00 INSTRUMENTS FOR PROCESS SYSTEM ATTACHMENT						
INSTRUMENT SCHEDULE						
DRAWING	INSTRUMENT TAG	BID TYPE	INSTRUMENT TYPE	LOCATION	RANGE/SETPOINT	PROVIDED BY
I-003	LE/LIT-1001A	BASE	RADAR LEVEL WITH INTEGRAL TRANSMITTER	LIFT STATION	0 - 30 feet (23 - 53 elev)	PCSS
I-003	LE/LIT-1001B	BASE	RADAR LEVEL WITH INTEGRAL TRANSMITTER	LIFT STATION	0 - 30 feet (23 - 53 elev)	PCSS
I-003	LSHH-1001	BASE	FLOAT SWITCH	LIFT STATION	37.0 elev	PCSS
I-003	LS3-1001	BASE	FLOAT SWITCH	LIFT STATION	35.0 ele	PCSS
I-003	LS2-1001	BASE	FLOAT SWITCH	LIFT STATION	34 elev	PCSS
I-003	LS1-1001	BASE	FLOAT SWITCH	LIFT STATION	31.5 elev	PCSS
I-003	LSLL-1001	BASE	FLOAT SWITCH	LIFT STATION	28 elev	PCSS
I-003	PI-1001	BASE	PRESSURE GAUGE	LIFT STATION	0 - 50 psi	PCSS
I-003	PSH-1001	BASE	PRESSURE SWITCH	LIFT STATION	26 psi	PCSS
I-003	PE-1001	BASE	PRESSURE SEAL (PLANAR)	LIFT STATION	50 psi	PCSS
I-003	PI-1002	BASE	PRESSURE GAUGE	LIFT STATION	0 - 50 psi	PCSS
I-003	PSH-1002	BASE	PRESSURE SWITCH	LIFT STATION	26 psi	PCSS
I-003	PE-1002	BASE	PRESSURE SEAL (PLANAR)	LIFT STATION	50 psi	PCSS
I-003	PI-1003	BASE	PRESSURE GAUGE	LIFT STATION	0 - 50 psi	PCSS
I-003	PSH-1003	BASE	PRESSURE SWITCH	LIFT STATION	26 psi	PCSS
I-003	PE-1003	BASE	PRESSURE SEAL (PLANAR)	LIFT STATION	50 psi	PCSS
I-003	FE/FIT-1102	BASE	MAGNETIC FLOW METER (LINE SIZE 18")	LIFT STATION	0 - 5000 gpm	PCSS
I-004	LE/LIT-1008	ALTERNATE	ULTRASONIC LEVEL WITH REMOTE TRANSMITTER	SODIUM HYPOCHLORITE TANK #1	0-12 feet	PCSS
I-004	LE/LIT-1009	ALTERNATE	ULTRASONIC LEVEL WITH REMOTE TRANSMITTER	SODIUM HYPOCHLORITE TANK #2	0-12 feet	PCSS
I-004	PI-1010	ALTERNATE	PRESSURE GAUGE	SODIUM HYPOCHLORITE SYSTEM	0-80 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-004	PI-1011	ALTERNATE	PRESSURE GAUGE	SODIUM HYPOCHLORITE SYSTEM	0-80 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-004	PSH-1011	ALTERNATE	PRESSURE SWITCH	SODIUM HYPOCHLORITE SYSTEM	75 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-004	PI-1012	ALTERNATE	PRESSURE GAUGE	SODIUM HYPOCHLORITE SYSTEM	0-80 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-004	PI-1013	ALTERNATE	PRESSURE GAUGE	SODIUM HYPOCHLORITE SYSTEM	0-80 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-004	PSH-1013	ALTERNATE	PRESSURE SWITCH	SODIUM HYPOCHLORITE SYSTEM	75 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-004	PI-1014	ALTERNATE	PRESSURE GAUGE	SODIUM HYPOCHLORITE SYSTEM	0-80 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-004	PI-1015	ALTERNATE	PRESSURE GAUGE	SODIUM HYPOCHLORITE SYSTEM	0-80 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-004	PSH-1015	ALTERNATE	PRESSURE SWITCH	SODIUM HYPOCHLORITE SYSTEM	75 psi	SODIUM HYPOCHLORITE SYSTEM SUPPLIER
I-005	LE/LIT-1010	ALTERNATE	ULTRASONIC LEVEL WITH REMOTE TRANSMITTER	SODIUM BISULPHITE TANK #1	0-10 feet	PCSS
I-005	LE/LIT-1011	ALTERNATE	ULTRASONIC LEVEL WITH REMOTE TRANSMITTER	SODIUM BISULPHITE TANK #2	0-10 feet	PCSS
I-005	PI-1016	ALTERNATE	PRESSURE GAUGE	SODIUM BISULPHITE SYSTEM	0-80 psi	SODIUM BISULPHITE SYSTEM SUPPLIER
I-005	PI-1017	ALTERNATE	PRESSURE GAUGE	SODIUM BISULPHITE SYSTEM	0-80 psi	SODIUM BISULPHITE SYSTEM SUPPLIER
I-005	PSH-1017	ALTERNATE	PRESSURE SWITCH	SODIUM BISULPHITE SYSTEM	75 psi	SODIUM BISULPHITE SYSTEM SUPPLIER
I-005	PI-1018	ALTERNATE	PRESSURE GAUGE	SODIUM BISULPHITE SYSTEM	0-80 psi	SODIUM BISULPHITE SYSTEM SUPPLIER
I-005	PI-1019	ALTERNATE	PRESSURE GAUGE	SODIUM BISULPHITE SYSTEM	0-80 psi	SODIUM BISULPHITE SYSTEM SUPPLIER
I-005	PSH-1019	ALTERNATE	PRESSURE SWITCH	SODIUM BISULPHITE SYSTEM	75 psi	SODIUM BISULPHITE SYSTEM SUPPLIER

SECTION 40 70 00
INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section covers the furnishing, installation, and services of instruments.

B. Vendor-provided instrumentation as indicated on the Drawings, shall conform to these specifications.

C. Instrumentation ranges and setpoints will be indicated on the Instrumentation drawings.

D. The instruments provided should follow the defined area classifications.

E. Furnish and install instruments with surge protection, sun shields, and any other requirements as applicable, as detailed in Section 40 61 13 Process Control System General Provisions.

F. Refer to Section 40 61 13 Process Control System General Provisions.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 40 61 13.

1.03 RELATED WORK

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.04 SUBMITTALS

A. Submit complete documentation of all field instruments using ISA-TR20.01.01-2007 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.

B. Submit separate data sheets for each instrument including:

i. Plant Equipment Number and ISA tag number per the Drawings.

ii. Product (item) name used herein and on the Drawings.

iii. Manufacturer's complete model number.

iv. Location of the device.

v. Input-output characteristics and signal protocol.

vi. Range, size, and graduations in engineering units.

vii. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with requirements.

viii. Materials of construction for enclosure and wetted parts.

ix. Instrument or control device sizing calculations where applicable.

x. Certified factory calibration data for all flow metering devices.

xi. Two-wire or four-wire (field powered) device type as applicable.

C. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

D. Submit index and data sheets in electronic format as well as hard copies in 8½-inch x 11-inch formats. The electronic format shall be Microsoft Excel or Word. Submit an electronic copy on CD-ROM or DVD disk.

1.05 MAINTENANCE

A. Refer to Section 40 61 13 Process Control System General Provisions.

1.06 PRODUCT HANDLING

A. Delivery, storage, and handling of equipment shall be in accordance with Division 01 - Basic Product Requirements and as specified herein.

B. All equipment and parts must be properly protected against any damage during shipment. Store the equipment in accordance with Manufacturer's recommendations.

C. All completely assembled units shall be offloaded using a primary and "tail" crane system. Additionally, when lifting the units from a horizontal position to a vertical position, the use of a primary and "tail" crane system shall be used.

D. Long-Term Storage:

i. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication, including storage in accordance with the Manufacturer’s requirements until the unit and equipment are ready for operation.

ii. If long-term storage is required on-site, Subcontractor shall follow Manufacturer's detailed recommendations for long-term storage.

E. Factory-assembled parts and components less than 25 feet in length shall not be dismantled for shipment unless permission is received in writing from the Engineer/Owner.

F. For units greater than 25 feet in length that are shipped unassembled, all connecting parts shall be "match-marked" by the Manufacturer to ensure correct assembly on-site by the Subcontractor.

G. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built, and securely bolted thereto.

H. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

I. No shipment shall be made until approved in writing.

1.07 WARRANTY

A. All equipment supplied under this Section of the Specifications shall be warranted by the Equipment Manufacturer for the warranty period specified in this section and if not specified then follow Division 01 – Basic Product Requirements.

B. The Project Warranties Period shall commence on the Date of Substantial Completion. Substantial Completion will be determined and approved by the Owner Project Director.

C. The equipment shall be warranted to be free from defects in workmanship, design, and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.

D. The Manufacturer's warranty period shall run concurrently with the Subcontractor's warranty period. No exception to this provision shall be allowed.

E. Refer to Division 01 - Closeout Procedures for additional warranty requirements.

1.08 INSTRUMENT TAGS

A. A permanent stainless steel or other non-corrosive material tags firmly attached by stainless-steel fasteners or stainless-steel wire, and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.

B. Provide 1/8-inch by 3/8-inch, Type 316 stainless steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless-steel identification tag attached to each transmitter and element prior to shipment. The tag shall be attached via stainless steel chain or stainless-steel wire (24-gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. The tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-inch high alphanumeric characters.

1.09 APPROVALS/CERTIFICATIONS

A. Instruments for hazardous locations shall have Factory Mutual (FM), Canadian Standards Association (CSA us), or UL approvals and certifications as specified herein and as indicated on the Drawings. The instrument shall have a stainless-steel tag identifying the relevant approval or certification.

1.10 MANUFACTURERS' START-UP AND TRAINING SERVICES

A. If indicated in the individual instrumentation paragraphs, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS or AESS Subcontractor.

B. The start-up services shall be to execute the field calibration if need it or perform the verification of the manufacturer calibration, oversee the installations of the sensor, and start up the sensor/transmitter in order to provide reliable measurement at the instrument and to a remote system. The vendor shall work with the PCSS and AESS to verify the transmitter sends correct information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface).

1.11 MANUFACTURERS' TRAINING SERVICES

A. While the instrument manufacturer or manufacturer's certified service representative is starting up the instrumentation, training shall be provided to the Owner's instrumentation technicians. The training shall be on how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

B. Refer to Section 40 61 26 Process Control System Training.

PART 2 PRODUCTS

2.01 LEVEL INSTRUMENTS

A. NON-CONTACT 2 WIRE RADAR LEVEL TRANSMITTERS (Measuring Range > 66 ft)

i. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

a. Vega VEGAPULS 64

b. Endress+Hauser

c. Or Approved Equal

ii. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

iii. General

a. Principle: To pulse W Band signals from the transducer toward the liquid and receive the echo measuring the time between sending and receiving the pulse signal and proportioning that to the measured liquid depth.

iv. Type:

a. 316 SS Antenna sensor

b. Wetted parts 316L

c. Horn Antenna

v. Function Performance

a. Function: To sense variable liquid level.

b. Voltage supply: 9.6 to 35 VDC

c. Range Capability: 1 foot to 99 feet

d. Process temperature: -196…200 °C (-320.8 to +392 °F)

e. Ambient temperature: -40…80 °C (-40 to +176 °F)

f. Process pressure: -1 to +25 bar

g. Accuracy. ±1 mm

h. Frequency range: W-band, 80GHz

i. Signal output: 4-20 mA/Hart – two-wire

j. Beam Angle: ≥ 3°

k. Shall have integral temperature compensation unit.

l. Ratings: Explosion proof, Class I, Group D, Division 1 or 2 installations.

vi. Physical

a. Mounting: flange mounted. Flange shall be 150 lb. RF, 316 SS.

b. Antenna shall be shaped to optimize reading accuracy and desired location.

vii. Options/Accessories

a. Provide stainless steel hardware.

b. Provide remote transmitter with display and controls as recommended by the manufacturer. Refer to the instrument schedule for requirements.

viii. Spare Unit: Provide a spare unit in addition to the unit installed.

ix. Warranty: 18 Months Minimum from the time instrument is accepted by the Owner.

B. NON-CONTACT 2-WIRE RADAR LEVEL TRANSMITTER (Measuring Range < 66 ft)

i. Manufacturer:

a. Vega: VegaPULS 23

b. Endress+Hauser: Micropilot M FMR20.

c. Or approved equal.

ii. Description: 2-wire loop-powered non-contact radar level transmitter. The transducer full PVDF body to suit the chemical conditions of each tank.

iii. Measuring ranges: 20m/ 66ft.

iv. Process temperature: -40 to +80 °C (-40 to +176 °F)

v. Process pressure: -1 ... 3 bar

vi. Accuracy: ± 2 mm

vii. Frequency range: W-band, 80 GHz

viii. Beam angle: 4°

ix. Materials, wetted parts: PVDF

x. Ingress protection: IP66 / IP68

xi. Power supply: 10.5 to 30Vdc, 2-wire

xii. Current output: 2-wire; 4-20mA HART

xiii. Ambient temperature: -40 to +80 °C (-40 to +176 °F)

xiv. Transmitter: Bluetooth wireless technology

xv. Cable length: As required.

xvi. Provide a remote transmitter with display and controls as recommended by the manufacturer. Refer to the instrument schedule for requirements.

xvii. Process Connections Front Side: 1" NPT

xviii. Ratings: Explosion proof, Class I, Group D, Division 1 or 2 installations.

xix. Spare Unit: Provide a spare unit in addition to the unit installed.

xx. Warranty: 18 Months Minimum from the time instrument is accepted by the Owner.

C. FLOAT-TYPE LEVEL SWITCHES

i. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

a. Contegra FS-90

b. Flygt Model ENM-10.

c. Endress+Hauser FTS20

d. Approved Equal

ii. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

iii. General

a. Provide sufficient lengths of Manufacturer's specialty cables for installation of power and signal conductors as provided with each instrument.

iv. Type:

a. The switch assembly shall be weighted and suspended on its own cable.

v. Function/Performance:

a. Temperature Rating: 0-50 degrees C.

b. Contact Rating: Up to 150V AC/DC and 1 amp AC, 1 amp DC.

c. Contact Arrangement: Form C contact which is a field selectable normally open or closed.

vi. Physical:

a. Contact: Sealed mercury-free switch housed in a chemical-resistant polypropylene or Stainless-Steel casing.

b. Switch shall have a rating for the area in which it is installed.

c. Flexible Support Cable: Synthetic four-wire cable, minimum 19 AWG wires.

d. Specific Gravity: Match to the fluid being measured.

vii. Power Requirements

a. None

viii. Required Options/Accessories

a. Provide flexible support cable of sufficient length to ensure no splice or connection is required in the wet well.

b. Provide junction box rated for the area in which it is installed.

c. Provide stainless steel supports/mounting accessories as required.

ix. Installation

a. Provide All Hardware from the manufacturer for the installation as described and shown on the plans.

b. Provide stainless steel wire ties for all cables within the wet well area or exposed to outdoor environments.

2.02 PRESSURE INSTRUMENTS

A. PRESSURE GAUGE

i. Type:

a. Bourdon tube style. As the process pressure increases inside the tube, the tube will straighten, causing the tip to deflect. The deflection is transferred to the dial indicator by a mechanical linkage.

b. Function/Performance

1) Pressure Range: As indicated on the contract documents or as listed in the instrument list.

2) Accuracy: 1.6 % of Full Scale

3) Over Range Protection: 125 % of Full Scale

4) Engineering Units: psi or as shown in the drawing or listed in the instrument schedule.

5) Ambient Temperature Range: - 40° F to 140° F (-40° C to 60° C)

6) Operating Process Temperature Range: -4° F to 176° F (-20° C to 80° C)

7) Filling Liquid: Glycerin, silicone, or mineral oil. Filling oil shall be compatible with process fluid where the gauge is installed. The contractor shall consult the manufacturer for the proper fill material used in chemical applications. All gauges shall be filled at the factory.

8) Diaphragm seal shall be provided on all chemical applications.

9) Pointer Travel: Not less than 200°; no more than 270°.

ii. Physical:

a. Case Material: 316-stainless steel, all-welded construction

b. Pressure element and tip material: 316- stainless steel

c. Window: Polycarbonate or laminated shatter-resistance glass window

d. Dial size and materials: 4” diameter, white aluminum with black lettering

e. Pointer Material: Black painted aluminum alloy

f. Process Connection: 1/2” NPT

iii. Accessories Required:

a. Shutoff valve: Each gauge shall have a process shutoff valve, which can also be used as an adjustable pressure snubber.

b. All related items for a complete installation

iv. Manufacturer(s)

a. Ametek – U.S. Gauge Division

b. Ashcroft

c. Noshok

d. Approved Equal.

B. PRESSURE/ DIFFERENITIAL PRESSURE SWITCH

i. Type:

a. Diaphragm-sealed piston actuated. Process pressure, acting on the piston, causes it to overcome the adjustment spring force and actuate a snap-action switch.

ii. Function/Performance

a. Power requirement: 250 VAC at 15 amps, 30 VDC at 5 amps

b. Alarms: minimum of one SPDT relay

c. Minimum Operating Pressure Range: 0 to 500 psi

d. Ambient Operating Temperature Range: -20 to 150 ^{o}F (-6 to 65^{o} C).

e. Process Operating Temperature Range: 0 to 200^{o} F (-20 to 100^{o} C) depending on materials selected).

f. Repeatability: 1.00 % of full scale.

g. Set Point: Field adjustable over the entire range.

h. Dead band:

1) Pressure Switch: Field adjustable

2) Differential Pressure Switch: Factory set.

i. Instrument shall be provided with an automatic reset function.

j. Over Range Protection: protection to maximum process line pressure.

k. Diaphragm seal shall be provided on all chemical applications.

iii. Physical:

a. Actuator diaphragm seal material: 316-stainless steel on all water applications. Material shall be compatible with process fluid where the switch is installed. The contractor shall consult with the manufacturer for the proper diaphragm material on all chemical applications.

b. Housing Material: NEMA 4X (IP 65), 316-stainless Steel.

c. Process Connection:

1) Pressure Switch: 1/2" NPT

2) Differential Pressure Switch: 1/4" NPT

iv. Options/Accessories Required:

a. Shutoff valve: Each gauge shall have a process shutoff valve, which can also be used as an adjustable pressure snubber.

b. 316-stainless steel tag shall be provided.

v. Manufacturer(s)

a. Static-O-Ring (SOR)

b. Ashcroft

c. United Electric

d. Approved Equal

C. DIAPHRAGM SEAL – PLANAR TYPE

i. Type:

a. A flexible diaphragm is used to separate the process fluid and pressure instrument, in order to protect the instrument's wetted parts. The space on the instrument side of the diaphragm shall be completely filled with a suitable pressure-transmitting fluid. Process pressure, acting on the diaphragm and the transmitting fluid, forces the pressure instrument (gauge or switch) to respond.

ii. Function/Performance

a. If a flanged process connection is used, ANSI Class 150/300 flange shall be provided. The diaphragm seal shall be attached to the flange as specified in ASME 16.5. The instrument supplier shall coordinate with the process piping contractor.

b. Welded metal, bonded elastomer, or bonded thermoplastic diaphragm.

c. Operating Pressure Range: 0 to 500 psi

d. Operating Process Temperature Range: -40^{o} F to 300^{o} F (-40^{o} C to 200^{o} C)

iii. Physical:

a. Top Housing: 316-stainless steel

b. Diaphragm Material: 316-stainless steel on all water applications. Material shall be compatible with process fluid where the switch is installed. The contractor shall consult with the manufacturer for the proper diaphragm material for all chemical applications.

c. Bottom Housing Material: 316 stainless steel on all water applications. Material shall be compatible with the process fluid where the diaphragm seal is installed. The contractor shall consult with the manufacturer for the proper bottom housing material on all chemical applications.

d. Bolts, Nuts, and Plugs: 316-stainless steel

e. Process Connection: 1/2” NPT

f. Sensing fill fluid: Silicone

iv. Options/Accessories Required:

a. Flushing Connection: flushing connection and plug shall be provided on all units. The plug shall be of the same material as the bottom housing.

v. Manufacturer(s)

a. Ashcroft - 200 series diaphragm seals

b. Noshok

c. Approved Equal.

D. DIAPHRAGM SEAL – ANNULAR (CONCENTRIC) TYPE

i. Type:

a. Wafer or spool-design flexible diaphragm used to separate the process fluid and pressure instrument in order to protect the instrument's wetted parts. The line of pressure is sensed 360° around the full inside circumference of the pipeline. The captive fluid is displaced through the pressure sensor body to the pressure instrument.

ii. Function/Performance

a. The pressure sensor shall be full flange and flow-through design with a flexible elastomer sensing ring around the full circumference.

b. The elastomer sensing ring shall be rigidly clamped between metal and cover flanges.

c. The pressure sensor shall be designed to fit between standard ANSI B16.1, Class 150, or 300 pipeline flanges. Flange bolts shall pass through the sensor body and flanges.

d. Minimum Operating Pressure: Limited only by ASME flange pressure limitations.

e. Operating Process Temperature Range: Up to 350° F (170° C) (depending on material).

iii. Physical:

a. Assembly flanges Material of Construction: 316 stainless steel on all water applications. Material shall be compatible with process fluid where the sensor is installed. The contractor shall consult with the manufacturer for the proper diaphragm material on all chemical applications.

b. Sensor Material of Construction: Shall be compatible with the physical and chemical properties of the process fluid.

c. Filling Liquid: Shall be compatible with the physical and chemical properties of the process fluid.

d. Process Connection: As noted in loop diagrams or piping drawings. Flanged for piping greater than 2", threaded NPT or flanged for piping 2" or smaller. Coordinate with piping contractor.

e. Pressure Instrument Connection: 1/2" to 2" depending on the pressure instrument specified.

iv. Manufacturer(s)

a. Ashcroft: Type 80 isolation ring, Type 85 isolation spool, or Type 86 isolation spool

b. Red Valve: Series 40, Series 48, Series 42, or series 742 diaphragm isolators

c. Noshok Type 40.

d. Approved equal.

2.03 FLOW INSTRUMENTS

A. MAGNETIC FLOW METERS

i. Type:

a. Pulsed DC electromagnetic sensor based on Faraday's law of induction. The flowing medium corresponds to the moving conductor. The induced voltage is proportional to the flow velocity and is detected by two measuring electrodes.

ii. Monitor/Transmitter

a. Performance

1) Power: 120 VAC 50/60 Hz (circuit from proposed panelboard) with manufacturer's battery backup

2) Unit shall have a local display.

3) Output: One - isolated 4-20 mA analog signals, programmable over the entire flow range. System to have HART Communication.

4) Output: Two - isolated discrete pulse for Repeater to PLC inputs. System to have HART Communication.

5) Alarms: Two Discrete programmable outputs

6) All circuits for inputs, outputs, and power supply shall be galvanically isolated from each other.

7) Full-Scale Range: 1 – 40 ft/sec - configurable in user-definable flow units

8) Accuracy: 0.5 % of reading or better

9) Repeatability: $\pm$ 0.1 of reading

10) Operating Temperature Range: -32^{o} F to 122^{o} F (0^{o} C to 50^{o} C)

b. Calibration: All flow meters shall be wet calibrated by direct volume comparison before leaving the factory. A copy of the calibration report shall be provided in the O&M manual. Each flow tube shall be factory calibrated in an ISO 9001 and NIST-certified facility and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters.

c. Display functions: 7-digit segment numeral and sign display for custom configurations to present different measured values and status variables for the following parameters: actual flow, forward, reverse, and a minimum of one totalizer. The transmitter shall display zero flow in the event of no flow through the process pipe. The meter shall also indicate "Empty Pipe".

d. Modular design for remote mounting. The monitor/transmitter shall be connected to one flow element. Connecting more than one flow element to a single transmitter shall not be allowed.

e. Physical

1) Wall or stand-mounted enclosure. The enclosure shall be NEMA 4X (IP 65), die-cast aluminum with electrostatic powder or polyurethane coating. All mounting hardware shall be 316-stainless steel.

2) Signal Cable: Provided by the manufacturer with sufficient length to reach the sensor without the risk of any electromagnetic interference.

3) Transmitter shall be provided with a sun shield if mounted outside.

iii. Sensor

a. Performance

1) Conductivity Limits: 5µS/cm for all fluids, 20µS/cm for drinking water

2) Meter Size: As shown on the contract documents or as listed in the instrument schedule

3) Meter shall be capable of running empty indefinitely without damage to any of the sensor components. Meter output shall be driven to zero (4 mA) when the process pipe is empty.

4) Process Temperature Range: 0^{o} F to 140^{o} F (-18^{o} C to 60^{o} C)

5) Ambient Temperature Range: -13^{o} F to 140^{o} F (-25^{o} C to 60^{o} C)

6) Pressure Ratings (at 60^{o} C): 150 psi if 150-lb flange is used; 450 psi if 300-lb is used.

7) Electrode Design: Solidly fitted, flush-mounted electrodes.

8) Grounding: The meter shall be grounded per the manufacturer's recommendation. Grounding rings, ground wires, gaskets, etc., shall be provided as required. All grounding materials shall be compatible with the fluid being measured.

b. Physical

1) Metering Tube Material: 304 or 316-stainless steel with carbon steel flanges or and polyurethane coating. Wafer-style configurations are acceptable for chemical feed lines sizes 1" and below.

2) Measuring Tube Liner Material: Teflon or Tefzel for all chemical - lines with pipe diameters of 12", Hard Rubber or Polyurethane for all sludge applications, and water lines with pipe diameters greater than 2".

3) Electrodes Material: 316-stainless steel or Nickel Alloy for all water and sludge applications. For all chemical lines, the contractor shall consult with the meter manufacturer to ensure that the material of construction of the electrodes used is compatible with the fluid where the meter is installed.

4) Meters in below-grade vaults, basements, etc. shall be NEMA-6 (IP 68) rated. Meters above grade shall be NEMA-4X rated. Meters located in hazardous locations shall be - Class 1, Div.2 rated. For IP 68 applications, cable shall be factory installed to ensure sealing.

iv. Accessories/Options

a. Provide a cleaning system as a standard option from the flow meter manufacturer. All necessary hardware, cables and connectors shall be provided.

v. Warranty. Provide a 3-year Factory Warranty for parts and labor from the time of Substantial Completion or the equipment installation is complete and accepted by the Owner for operation, whichever occurs later.

vi. Manufacturer:

a. ABB

b. Siemens

c. Rosemount

d. Endress and Hauser

2.04 SPARE PARTS AND ACCESSORIES

A. General requirements for spare parts are specified in Section 40 61 13 Process Control System General Provisions.

B. The following field Instrument related Spare Parts shall be furnished:

i. One flow indicating transmitter for each type of flow element provided.

ii. One level indicating transmitter for each type of level element provided.

iii. One spare float type level switch for each type provided.

C. The following accessories shall be furnished:

i. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.

ii. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

PART 3 EXECUTION

3.01 GENERAL

A. See execution requirements in Section 40 61 13 Process Control System General Provisions.

B. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

END OF SECTION

APPENDIX 40 70 00: INSTRUMENTATION FOR PROCESS SYSTEMS

SEE ATTACHMENT

SECTION 40 78 63
AUTODIALER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cellular Auto dialer and enclosure.

1.02 REFERENCES AND STANDARDS

A. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Comply with Section 01 33 23 - Submittal Procedures.

B. Submit shop drawings indicating layout of completed assemblies, interconnecting cabling, dimensions, weights, and external power requirements.

C. Submit product data for each component specified.

D. Submit manufacturer's installation instructions.

1.04 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Section 01 77 00 - Closeout Procedures.

B. Accurately record actual locations of controller cabinets and input and output devices connected to system. Include interconnection piping, wiring and cabling information, and terminal block layouts in controller cabinets.

C. During drawing submittal phase, submit detailed programming information consisting of ladder logic, and complete input, output, relay, register and controller identification labels.

D. Submit factory testing procedures proposed to verify input, output, PID loop and register operations, system logic verification, and spare memory capacity.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation in accordance with Section 01 78 23 - Operations and Maintenance Data.

1.06 QUALIFICATIONS

A. Manufacturer: A company specializing in manufacturing the products specified in this Section having at least 5 years documented experience maintaining service facilities within 100 miles of project and having proven compatibility with wastewater facilities. Like devices shall be of the same Manufacturer.

1.07 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and shown; install in accordance with UL requirements.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver products in factory-sealed containers. Store, handle and protect products under the provisions of Division 40.

B. Upon delivery, inspect products for damage.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature above 32 degrees F and below 104 degrees F during and after installation of products.

B. Maintain area free of dirt and dust during and after installation of products.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. RACO Verbatim with Cellularm Option

B. Or Equal

2.02 MATERIALS AND EQUIPMENT

A. General Requirements:

1. Electronic system shall interface alarms to telephone network on preselected basis.

2. Upon receipt of one or more critical alarm trips, electronic system will automatically dial out onto public phone system with pre-programmed messages.

a. System shall continue calling until call completed and acknowledged.

B. Auto Dialer:

1. Description and Phone Number Dialing:

a. The dialer shall be a solid state component capable of dialing up to 16 telephone numbers, each up to 24 digits in length. Phone numbers and Standard pulse dialing or Touch Tone® DTMF dialing are user programmable via the system's keyboard or remotely via Touch Tone telephone. In addition, the dialer shall:

1) Group Alarm Calls - On alarm, system shall selectively call the correct phone number according to the specific alarm(s).

2) Detect Telephone Line Fault and indicate condition with Front Panel LED.

3) Automatically select Tone versus Pulse Dialing.

4) Monitor Call Progress - Detect Busy and Ringing Signals, Abandon Call if Busy, Wait until phone is answered to Annunciate Voice Reports.

5) Provide Numeric Pager Support

6) Provide PBX Support

2. Solid State Voice Message Recording and Playback:

a. The unit shall have two different categories of speech message capability, all implemented with permanent non-volatile solid state circuitry with no mechanical mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel.

1) User Field Recorded Messages:

a) The user may record and re-record their own voice messages for each input channel and for the Station ID.

b) There shall be no limit on the length of any particular message within the overall available message recording time, which shall vary from 26 to 635 seconds, depending upon the number of input channels selected, and the recording rate used.

c) The unit shall allow selective recording of both Normal and Alarm advisory messages for each input channel.

d) The unit shall provide for automatic setting of the optimum speech recording rate for the total set of messages recorder, to achieve optimum recording sound quality.

e) Circuit board switches or jumper straps shall not be an acceptable means of manipulating message length or recording rates.

f) Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of their own.

3. Input Monitoring Function:

a. The basic unit shall continuously monitor the presence of AC power and the status of four (4) contact closure inputs. AC power failure, or violation of the alarm criteria at any input shall cause the unit to go into alarm status and begin dial-outs. The unit shall, upon a single program entry, automatically accept all input states as the normal non-alarm state, eliminating possible confusion about Normal Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently "Closed Circuit" or "Open Circuit" without disturbing any message programming. Each input channel shall also be independently programmable, without the need to manipulate circuit board switches or jumpers, to any of the following:

1) Normally Open, Normally Closed, or for No Alarm (Status Only).

2) Run Time Meter - to accumulate and report the number of hours a particular input circuit has been closed. Any channel so configured will never cause an alarm call; rather, on inquiry it will recite its message according to the status of the input and then report the closed circuit time to the tenth of an hour. The input will accumulate and report in tenths of hours up to a total accumulated running time of 99,999.9 hours. The initial value of the Run Time Meter shall be programmable in order to agree with existing electromechanical Run Time Meters. Up to a total of eight Run Time Meters may be programmed.

3) Pulse Totalizer - to count the accumulated number of pulses (momentary contact closures) occurring at the input so programmed. Any input channel may be programmed for a Totalizer Function, up to a maximum of eight. Maximum Input pulse rate is 100 Hz, with a 50% Duty Cycle. The spoken scaled value will not "rollover" to zero until a value of 4,294,967,294 has been exceeded.

4. Input/Output Expansion Capability:

a. The standard unit shall be modular in design, permitting it, therefore, to accept "plug-in" expansion circuit boards to incorporate any of the following:

1) Contact Closure Expansion Capability to a total of 8, 16, 24, or 32 total dry contact inputs.

2) Analog Input Capability to a total of 1, 4, 8, or 16 total analog inputs.

3) Remote Supervisory Control Outputs to manipulate 4 or 8 output relays.

5. Modbus Communications:

a. The unit shall accept an expansion card which enables it to communicate directly with devices utilizing Modbus RTU Protocol. A unit so configured shall

be capable of "reading" and "writing" to 32, 64, or 96 data registers via Touch Tone Telephone. No modem or host computer shall be required. Interface shall consist of a single RS-232.

6. Printer/Computer Communications:

   a. The unit shall be equipped with a centronics parallel printer port, enabling the user to print alarm reports, download programming data, and generate scheduled status reports as required. Alternatively, the unit shall be able to accept an optional modular, plug-in asynchronous communications card to permit any of the following:

      1) Local Data Logging - Permits a single dialer to communicate with a local Serial printer to log routine status reports, alarm reports, and programming data.

      2) Central Data Logging - Permits one or more dialers to communicate with a single centrally located Serial printer equipped with a suitable modem to log routine status reports, alarm reports, and programming data.

      3) Data Acquisition and Control - Permits one or more dialers to communicate with a centrally located Computer/Printer System equipped with a SCADA software package, thereby functioning as a stand-alone SCADA system.

7. Alarm and Inquiry Messages:

   a. Upon initiating an alarm call, the system is to "speak" only those channels which are currently in "alarm status." Inquiry phone calls can be made directly to the unit at any time for a complete status report.

8. Acknowledgement:

   a. Alarms are acknowledged either by pressing a Touch Tone "9" as the call is being received, or by calling the unit back after having received an alarm call.

9. Nonvolatile Program Memory Retention:

   a. User-entered programming and voice messages shall be kept intact, even during power failures or when all power has been removed, for up to ten (10) years. This shall be accomplished through inclusion in the system of a lithium battery separate from the unit's backup rechargeable gel cell battery.

10. Local and Remote Programming Capabilities:

    a. The user may optionally elect to alter the following parameters from their standard normal default values via keyboard entry or remotely from any Touch Tone telephone.

1) Alarm Response Delay: 0.1 to 999.9 seconds, with different delays being assignable to different alarms.

2) Delay Between Alarm Call-outs: 0.1 to 99.9 minutes.

3) Alarm Reset Time: 0.1 to 99 hours, or "No Reset".

4) Incoming Ring Response (Answer) Delay: 1 to 20 Rings.

5) Number Of Message Repetitions: 1 to 20 Repetitions.

6) Autocall Test: When enabled, the unit shall place a single round of test calls, both at the time this function is enabled, and also at regular subsequent intervals until this function is disabled.

7) Remote System Microphone Activation.

8) Remote Arming and Disarming of System.

11. Phone Line:

    a. The dialer is to use a standard "dial-up" telephone line (direct leased line is not required) and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ 11).

12. Speakerphone:

    a. The unit shall be capable of dialing any phone number on command and functioning as a speakerphone.

13. Real Time Clock:

    a. The unit shall be equipped with a real time clock thereby making the following possible:

        1) Alarm Ready Schedule - The dialer shall be user programmable to follow a specific schedule of operations. This shall include the flexibility to set a weekday, weekend, and holiday schedule. With this feature the dialer shall arm and disarm itself according to the schedule programmed.

        2) In the event any of the printer configurations outlined in Section 6 are utilized, all alarm reports will be time and date stamped. Routine scheduled status reports can also be programmed.

14. Power/Battery Backup:

    a. Normal power shall be 105-135 VAC. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is

present. The system shall operate on battery power for a minimum of 20 continuous hours in the event of AC power failure. A shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger", to minimize recharge time and to maximize battery life available.

15. Integral Surge Protection:

    a. All power, phone line. dry contact. and analog signal inputs shall be protected at the circuit board to IEEE Standard 587. category B (6,000 volts open circuit/3,000 amps closed circuit).

C. Enclosure:

1. Dialer to be installed in a 316 Stainless Steel NEMA 4X Enclosure with mounting tabs for wall/rack mounting.

D. Warranty:

1. The dialer shall be covered by a five (5) year warranty covering parts and labor performed at the factory.

PART 3 EXECUTION

3.01 INSTALLATION

A. Furnish complete enclosure, factory tested and ready for installation and field termination.

B. Terminate wiring with spade lugs at terminal strips corresponding to designations on Drawings.

C. When not installed in plastic wireways, such as along back of door, neatly bundle and support internal panel wiring with self-adhesive nylon clips. Provide adequate slack for proper door operation without damage to wiring or tubing.

D. Identification: Identify system components in accordance with Section 16195 - Wiring and Conduit Identification.

1. Identify conductors and termination points (device and relay terminals).

2. Provide nameplates for panel-mounted devices and instruments as shown on drawings.

3.02 PROGRAMMING

A. Contractor shall be responsible for programming of dialer or shall enlist the services of a manufacturer's representative.

B. Programming Coordination Meeting:

1. Contractor shall coordinate a meeting with Project Manager and Owner/Owner's Representative to finalize programming requirements, prior to any programming being performed.

a. Dialer shall be, at a minimum, programmed to monitor inputs shown on Contract Drawings.

b. Other inputs may be required by Owner and shall be finalized at a coordination meeting.

c. Meeting shall determine phone numbers to dial, order of dialing, and events to dial on.

3.03 SYSTEM TESTING

A. Perform system test proving programming has been properly performed. Submit 2 copies of Final Programming and Field-Testing Reports. Replace components found to be defective.

END OF SECTION

SECTION 46 33 00A

LIQUID CHEMICAL FEED EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish, install and place into satisfactory operation a skid-mounted liquid chemical feed equipment.
B. Chemical feed equipment is intended to chlorine and sodium bisulfate.
C. Chemical feed rate will be controlled through a 4-20 mA signal from the effluent flow and thus requires a signal connection to the effluent flow measuring device.

1.02 REFERENCES

A. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
B. American Society of Mechanical Engineers (ASME):
C. ASTM International (ASTM):

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 23.
B. All submittals shall be approved by the Owner in writing prior to delivery and fabrication for specials.

1.04 OPERATION AND MAINTENANCE MANUALS

A. Provide three bound hard copy Operation and Maintenance Manuals.
B. Manuals shall include complete equipment data, operation requirements, storage, trouble shooting, spare parts list, equipment list, drawings, and catalog sheets.
C. Manual shall include preventative maintenance table identifying all parts and materials required and recommended frequency of maintenance.

1.05 WARRANTY

A. Provide Owner with written warranty for period of one year from the date of start up. If equipment should fail during the warranty period, Contractor shall return unit to operational service at no cost to Owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide QDOS feed skid by Watson Marlow of 1183 Brittmore Suite 100; Houston, TX 77043.
B. Provide scales adequate for chemical storage.
C. Provide nonmetallic secondary containment system.

D. Local manufacturers representative is Jeff Houston; Environmental Improvements, Inc. (EI2) 281-728-8808; jeff@ei2hou.com; 1183 Brittmoore, Suite 100 Houston, TX 77043.
E. Equipment from alternate manufacturers shall not be acceptable unless pre-approved two weeks prior to bid date per Section 01 62 00 Substitutions and Product Options.

2.02 PERFORMANCE REQUIREMENTS

A. All equipment of each type specified in this section shall be supplied by a single Supplier.
B. Each major piece of equipment shall be furnished with a nameplate securely mounted to the body of the equipment. As a minimum, the nameplate for the feed equipment shall include the equipment number, manufacturer's name and model number, serial number, rated flow capacity.
C. All equipment including controls and drives specified herein shall be specifically designed for the service environment encountered in this installation. The environment may be moist and corrosive.
D. Equipment shall be designed and capable of either continuous or intermittent operation.
E. All equipment, supports, anchors, and fasteners shall be of adequate strength to withstand loads associated with starting/stopping, turbulence, thrusts from liquid movement, thermal expansion, and contraction and other loads encountered under normal operating conditions.
F. The equipment shall be chemically compatible, as defined in this Section, with and capable of dosing the chemical solutions specified herein.

2.03 FEED SKID

A. The feed pump(s), piping, valves, instruments, and appurtenances shall be mounted to a chemical feed skid. The chemical feed skid shall be floor mounted, as indicated in the schedule.
B. The internal piping of the skid shall be sized as indicated in the table:

Design Flow of individual pump	Suction Pipe Size	Discharge Pipe Size
0-10 GPH	1/2"	1/2"
10-25 GPH	3/4"	1/2"
25-50 GPH	3/4"	3/4"
50-75 GPH	1"	3/4"
75-125 GPH	1"	1"
125-200 GPH	1-1/2"	1-1/2"
200-300 GPH	2"	1-1/2"

C. Overall skid dimensions shall not exceed the maximum dimensions shown on the Drawings.
D. Placement of commonly accessed or maintained pump accessories (valves, instruments, electrical, etc.) are not to exceed 6.5 feet in height above the finished floor.

E. Provide easy access for any normal replacement parts on skid, including ability to switch out replacement parts without disconnecting hard piping.
F. End partitions shall extend at least 6 inches behind the edge of pump shelving.
G. Provide a floor mounted pump and accessory support system for the pumps as shown on the Drawings.

2.04 CONSTRUCTION:

A. The materials of construction shall be as follows:
B. Skid Frame: Skid shall be one-piece rotationally molded UV stabilized HDPE. Welded HDPE is not acceptable.
C. Skid Mounting Board: 1/2" thick HDPE panels.
D. Skid frame shall have fork-lift cut-outs for easy installation.
E. Skid shall have a fully enclosed containment lip (2.5” depth minimum) and the interior skid floor shall be sloped to a valved drain connection.
F. Skid Pump Shelf: 1/2" thick HDPE panels.
G. Skid Hardware: Type 316 stainless steel
H. Pipe Clamps: Non-metallic clamps that accommodate pipe thermal expansion and contraction. Pipe clamps with threaded closure systems will not be accepted.
I. Piping: Where PVC and CPVC can be used, piping and fittings used for all on-skid piping shall meet chemical compatibility requirements and be Schedule 80. Solvent chosen by the SYSTEM INTEGRATOR shall be certified for chemical compatibility and approved by the ENGINEER. In applications where PVC and CPVC do not meet the definition for chemical compatibility, the chemical feed skid system integrator shall use an approved material that meets the definition used in this Section.
J. All components, including valve seals and seats, shall be compatible with the chemical service for which they will be used, as defined in this Section.

2.05 PERISTALTIC POSITIVE DISPLACEMENT PUMP

A. Pumps shall be Model Qdos by Watson Marlow positive displacement type complete with ReNu replaceable cartridge- style peristaltic pumphead technology and self-contained variable speed drive as specified.
B. Pumps shall be self-priming, and shall have a maximum suction lift capability of up to 30' vertical water column.
C. Discharge Pressure Rating: Up to 60 psi on Qdos 120 and up to100 psi on Qdos 30 & Qdos 60 continuous (145 psi intermittent for Qdos 30).
D. Pumps shall be capable of pumping both liquids and gases without vapor locking.
E. Pump shall not require the use of back pressure valves, suction foot valves, strainers, pulsation dampeners, or auto degassing valves and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components during operation.

2.06 PUMP CONSTRUCTION

A. Technology: Provide tool-free ReNu cartridge-style peristaltic pumphead technology. For operator safety, pumphead must be serviceable as a single replaceable component. Pumps that require an operator to open the pumphead for tube replacement, cleaning, or rebuilding or that require tools for maintenance are unacceptable.
B. Max rating: Qdos 30 - 7.9 GPH at 125 rpm and 100 psi of discharge pressure. Qdos 60 - 15.85 GPH at 125 rpm and 100 psi of discharge pressure. Qdos 120 - 31.7 GPH at 125 rpm and 60psi of discharge pressure.
C. Housing construction: corrosion resistant and high impact resistant glass filled PPS or PPE/PS.
D. Geometry: Pumphead shall consist of sealed track housing with in-line porting. Suction and discharge ports shall be 180 degrees apart with bottom suction and top discharge.
E. Rotor: Pumphead rotor shall be constructed of glass filled Nylon, sealed within the track housing, and supported by its own bearings. Peristaltic occlusion level shall be factory set to ensure flow accuracy of +/- 1% and repeatability performance of +/- 0.5% and shall not require any field adjustment.
F. Contact Materials: All pumphead components in the fluid path must be NSF61 listed and shall be of materials specified by the manufacturer as compatible with the process fluid.
G. Leak containment/detection: In the event of peristaltic element failure, the leak sensor shall shut the pump down immediately with all process fluid contained within the sealed pumphead.
H. Sensor type: Utilize non-contacting optical sensor. Sensor shall not come in contact with the process fluid, shall contain no moving parts, shall not depend on the capacitance of the process fluid, shall not require fluid to leak out of the pump housing for engagement, nor shall require any sensitivity or calibration adjustment.
I. Alarm: Sensor shall shut down the pump, give a visual indication on the drive controller, and if specified shall provide an output general alarm signal.
J. For operator and environmental safety, pumps which do not have leak containment, leak sensor, and shutdown are not acceptable. For additional overpressure safety, sealed pumphead shall have a controlled drain-to-waste port.
K. Port connections: Pumphead shall utilize polypropylene compression fittings which shall mate to 10mm ID reinforced, transparent PVC interface hose. Provide polypropylene compression by ½" NPT adaptors for connecting interface hose to process line.
L. Spares: Provide one (1) spare pumphead per pump supplied.

2.07 DRIVE

A. Rating: Continuous 24 hour operation, 45o C ambient.
B. Voltage: Drive shall be suitable for 100-240VAC, 50-60Hz, 1-Phase with an internal switch-mode power supply. Supply nine-foot length mains power cord with standard 115VAC three-prong plug.
C. Max drive power consumption: 190VA.
D. Enclosure: NEMA 4X constructed out of corrosion and impact resistant engineering plastic, 20% Glass filled PPE/PS. By nature of the environmental conditions, painted or unpainted metallic

housing including 316SS are not acceptable. Enclosure shall house the drive motor and all control circuitry in one integrated unit. Separate VFDs and motors are not acceptable.

E. Direct coupled pumphead with fully protected drive
F. Pumphead shall direct couple mount to the controller via a splined drive shaft and shall be locked in place by two tool-free thumbscrews or lever mechanism.
G. Pumphead shall be fully sealed to prevent any contamination of the controller or drive shaft by process fluid.
H. Pumphead shall contain its own rotor bearings and not impart an overhung load on the pump shaft.
I. Pumpheads shall be supplied mounted to the left or right side of the drive enclosure as specified in the drawings. If not specified, pumpheads shall mount to right side of the enclosure.
J. Drive shall stop shaft rotation and give visual alarm in the event the pumphead is removed.
K. Drive motor: brushless DC motor with integral gearbox and closed loop tachometer feedback.
L. Circuitry complete with temperature and load compensation and protection.

2.08 HUMAN-MACHINE INTERFACE (HMI) AND CONTROL

A. Comply with requirements of specification 26 01 95.
B. Provide controls and signal to allow chemical to be flow paced to influent flow through 4-20 mA signal. Provide signal connection to the influent flow measuring device.
C. Manual Control Interface
D. Flow range: Qdos 30 - 7,900:1 flow range from 0.001-7.9 GPH in 0.001 GPH increments.
E. Display: Backlit graphical TFT Display capable of up to 8 lines of text with up to 26 characters per line to display pump tag number, flow rate, and programming instructions. Display shall also provide visual indication of running status via screen color: Blue = Running, White = Stopped and Red = Warning.
F. Keypad: Keypad for start, stop, speed increment, speed decrement, rapid prime, and programming.
G. Flow units: Programmable in either ml/min or gallons/hour.
H. Security: Programmable keypad lock and PIN security for optional lockout of all keys except emergency start/stop.
I. Auto Restart: feature to resume pump status in the event of power outage interruption.
J. Multilingual menu: include programming menus in nine languages, including at a minimum English, Spanish, and French.
K. Fluid level monitor: Programmable flow totalization to advise operator when their supply tank is low.

2.09 REMOTE CONTROL I/O

A. Speed Control Input: Analog 4-20mA speed input with 1,600:1 turndown with incremental steps of 10 microamps.
B. Speed Control Input: Analog 4-20mA speed input with 1,600:1 turndown with incremental steps of 10 microamps. Signal must be trimmable and speed scaleable over any part of the drive

speed range. Pump shall be programmable to either increase pump speed or decrease pump speed against an increasing Analog 4-20 mA signal. ******

C. Run/Stop Input: Either 5-24V industrial logic, dry contact or powered 110 VAC contacts as shown per the process and instrumentation drawings.
D. Run/Stop & General Alarm Status Outputs: Either 24VDC Open Collector, 24VDC Status relay, or 110VAC Status Relay
E. Status Outputs: Two status outputs 24VDC Open Collector, 24VDC Status relay, or 110VAC Status Relay as required by the process and instrumentation drawings software configurable to indicate the following:

    1. General Alarm status
    2. Running/Stopped status
    3. Manual Mode status
    4. Analog Mode status
    5. Contact Mode status
    6. Fluid Level status
    7. Leak Detected status

F. Speed Analog Output: Analog 4-20mA
G. HMI, analog connections, and mains power shall be accessible from the front or side of the enclosure.

2.10 ACCESSORIES

A. Accessories listed below shall be furnished by the SYSTEM INTEGRATOR.
B. Each chemical feed skid shall have the following accessories:
C. Calibration column
D. Pulsation dampener with true union ball shutoff valve.
E. Pressure relief valve.
F. Sight glass with streamers.
G. Pressure gauge with protective seal diaphragm and true union ball shutoff valve.
H. Pressure switch to signal problem with the pumping unit.
I. True union ball isolation valves.
J. Solvent Welding

    1. Solvent welding compounds shall be compatible with the chemicals being pumped.
    2. When solvent welding PVC or CPVC pipe that is in sodium hypochlorite solution service, IPS Corporation Type 724 cement or similar cement certified by the manufacturer for high strength sodium hypochlorite service shall be used.

K. Calibration Chamber:

    1. Provide with shutoff true union ball valve on suction piping to each peristaltic pump.
    2. Chamber volume shall be sized to accommodate a 30 second (minimum) draw-down at the maximum design feed rate of the pumping system. The column shall be graduated in both mL and GPH.

3. The calibration column shall have threaded fittings on both the top and bottom. The top fitting shall be routed to the vent connection of the skid.
4. The column shall be installed at the lowest possible elevation to facilitate gravity filling. In suction lift applications, valving on the pump's discharge shall be provided for calibration column filling.
5. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
6. Acudraw PVC Calibration Column by Primary Fluids.

L. Pulsation Dampener:

M. Single-diaphragm type pulsation dampener, with true union ball shutoff valve, shall be installed on the discharge lines of each pump.

N. Dampener shall be of the air-charged type with pressure gauge to indicate charge pressure and to indicate dampening effectiveness. Initial charge to be set by the SYSTEM INTEGRATOR and noted on the installation certificate.

O. Materials of construction shall be compatible with chemical being pumped.

P. Size shall be indicated in the table below:

Displacement per Revolution	Dampener Size
Up to 0.0058 G	10 Cubic Inch
0.0058 G - 0.022 G	36 Cubic Inch
0.022 G – 0.079 G	85 Cubic Inch
0.079 G – 0.76 G	175 Cubic Inch

Q. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

R. Acupulse Pulsation Dampener by Primary Fluids.

S. Pressure Relief Valve:

1. Install on each pump discharge line. Pressure relief valve shall be the same size as the pumps discharge piping. Connection reducers are not acceptable.
2. Materials of Construction shall be compatible with the chemical being pumped.
3. Set point shall be field adjustable and initially set by the SYSTEM INTEGRATOR and noted on the installation certificate.
4. Pressure relief valve shall be of the spring opposed diaphragm type with threaded adjustment knob with lock-nut. Plunger or piston type pressure relief valves are not acceptable.
5. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
6. Top Valve Pressure Relief Valve by Primary Fluids

T. Sight Glasses:

1. Provide sight glass with streamers on each pump discharge line. Sight Glass shall be the same size as the pumps discharge piping. Connection reducers are not acceptable.
2. Materials of Construction shall be compatible with the chemical being pumped.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
4. Series GX by Plast-O-Matic.

U. Pressure Gauge:

1. Provide phenolic cased process type gauge with 316 stainless steel tube and socket on each pump discharge line, complete with true union ball isolation valve and diaphragm isolation.
2. Pressure Range: As shown on the drawings.
3. Dial: 4-inch minimum.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
5. Ashcroft (Type 1279)

V. Pressure Switch

1. The discharge of each pump shall be equipped with a pressure switch that shall turn off the pump, via hardwire, upon over pressurization. The pressure switch shall also report a signal of over pressurization back to SCADA.
2. Shall have NEMA 4X enclosure, Type 316 stainless steel wetted materials, and Viton actuator seal.
3. Pressure switch shall include true union isolation ball valve and diaphragm isolator.
4. Manufacturer:

W. Ashcroft Model B400

1. Pressure Instrument Diaphragm Isolator
2. The pressure switch and pressure gauge on the discharge of each pump shall include a diaphragm type isolator.
3. Isolator and instrument shall be factory assembled together and tamper-proof sealed. Fill fluid shall be non-reactive with the chemical being pumped.
4. Lower housing shall be ½" threaded connection minimum.
5. Lower housing and diaphragm materials to be compatible with the chemical being pumped.
6. Manufacturer:
7. Ashcroft Type 200

2.11 BALL VALVES

A. Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

B. PVC and CPVC Valves: Install using solvents approved for valve service conditions.
C. PVC Ball Valve 2 Inches and Smaller:
D. Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon 0-ring stem seals, to block flow in both directions.
E. Manufacturers and Products:
F. George Fischer type 546

2.12 PROCESS PIPING

A. Process Piping shall be PVC Sch 80
B. Join pipe and fittings in accordance with manufacturer's instructions
C. Threaded and Coupled Joints:
D. Conform to ANSI B1.20.1.
E. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
F. Countersink pipe ends, ream and clean chips and burrs after threading.
G. Make connections with not more than three threads exposed.
H. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets
I. Hangars and supports to be consistent with existing installation.
J. Item: Description
K. Pipe: Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with 2% titanium dioxide for ultraviolet protection.
    1. Threaded Nipples: Schedule 80 PVC
    2. All PVC pipe must bear the National Sanitation Foundation Seal of Approval, NSF-pw, as required by Texas Commission on Environmental Quality regulations.
L. Fittings : Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with 2% titanium dioxide for ultraviolet protection.
M. Joints: Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
N. Solvent Cement: IPS 724
O. Thread Lubricant: Teflon Tape.

2.13 SPARE PARTS

A. Provide adequate spare parts for one year of operation.
B. Provide spare metering pump head for each pump provided.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Protect parts so that no damage or deterioration occurs during a prolonged delay from the time of shipment until installation is completed.
B. Protect all equipment and parts against any damage during a prolonged period at the site.

C. Protect finished iron or steel surfaces not painted to prevent rust and corrosion.
D. Prevent plastic and similar brittle items from being exposed to direct sunlight and extremes in temperature.
E. Secure and maintain a location to store the material.

3.02 INSTALLATION

A. The equipment shall be installed per the contract documents and manufacturer's recommendations.

3.03 START UP

A. Manufacturer shall provide the services of a factory trained technician to check installation and verify proper operation. Start up services shall be a minimum on one day on site.
B. Contractor shall include all travel, expense, and coordination costs in bid.

3.04 FIELD QUALITY CONTROL

A. Until the equipment is accepted by the Owner, provide field operation and maintenance as required by manufacturer.
B. SBR manufacturer shall coordinate selection of chemical. Provide a minimum of two 330 gallon chemical totes chemical. Provide adequate chemical for testing and operation during startup, if additional chemical is required.

3.05 OPERATOR TRAINING

A. Manufacturer shall furnish the services of a factory trained service representative for one trip including one day of operator training on same day as start up. Contractor shall coordinate training to ensure equipment is operational and ready for training and Owner staff is available. Manufacturer shall submit written training agenda to Owner for approval at least seven days prior to training. Manufacturer shall provide written materials describing operation procedure, required maintenance frequency, and installation of spare parts.
B. Contractor shall include all travel, expense, and coordination costs in bid.

END OF SECTION